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## **GERMPLASM EVALUATION AND SELECTION OF SAFFLOWER OILS AND CO-PRODUCTS FOR ALTERNATE FUEL PRODUCTION**

*Prepared for*

**MONTANA DEPARTMENT of NATURAL RESOURCES and CONSERVATION**

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GERMPLASM EVALUATION AND SELECTION OF SAFFLOWER OILS AND  
CO-PRODUCTS FOR ALTERNATE FUEL PRODUCTION

AUG 18 1988

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December 1987

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TITLE: Germplasm Evaluation and Selection of Safflower Oils and Co-products for Alternate Fuel Production. Grant Agreement No. RAE-85-1054.

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PROJECT SCOPE: Safflower germplasm of the Eastern Agricultural Research Center safflower breeding and research program is the renewable energy resource for this research project. The project is to evaluate the safflower genetic material available for improved oleic type oil for fuel having high oil percentages, high meal protein content, reduced meal fiber content, improved amino acid profiles, and other desirable seed characteristics and agronomic traits to make production of safflower oil for fuel more economically feasible in Montana. Over 4,000 genetic lines of safflower were evaluated for the various constituents of agronomic and economic importance. Based on the results from this research project evaluation, 2,000 self progeny of the most promising genetic breeding lines of oleic type safflower identified from the first year's growing season in Milestone 3 were selected for evaluation and identification of superior progeny from the second year's growing season in Milestone 3A.

## ABSTRACT/EXECUTIVE SUMMARY

Safflower oil appears to have great promise as an alternate fuel for agricultural production in Montana to alleviate dependency on fossil fuels in the event of a fuel shortage and possibly help Montana farmers achieve energy self-sufficiency. Use of only 10 percent of the crop acreage for oilseed production could make Montana's agriculture industry nearly self-sufficient.

The cost of using safflower oil as a fuel in 1984 was estimated at \$2.47 per gallon. It is possible to reduce this cost to a cost similar to diesel fuel by 1995. Over 4,000 safflower genetic breeding lines were evaluated to identify and select improved oleic fuel safflower varieties having high seed oil percentages, high meal protein contents, reduced meal fiber content, improved meal protein, and improved amino acid profiles for industrial, livestock, and human use. The objectives of this research project were as follows:

- To add the necessary oilseed laboratory equipment to the Eastern Agricultural Research Center safflower breeding and oilseed research program facilities to permit the simple, rapid, and accurate analyses of safflower oils and co-products for alternative fuel.

- To grow small quantities of 4,000 potential safflower genetic lines to obtain seed samples for laboratory testing and sufficient excess seed for small plot tests of favorable selections.

- To conduct preliminary performance tests of the five currently available commercial oleic varieties (36% seed oil content) at six research centers throughout Montana to determine how the fatty acid composition varies according to planting location and growing temperature and to establish test locations in Montana for future testing.

- To perform laboratory testing and analyses of the safflower genetic lines and commercial oleic safflower varieties and self progeny of superior oleic safflower breeding lines.

- To prepare, complete, and submit a final report and a videotape of the research project to the Montana Department of Natural Resources and Conservation.

Milestone 1, Equipment Procurement, and Milestone 2, Sample Production, were completed and a report was submitted in February 1986. Milestone 3, laboratory analyses of 4,000+ safflower oilseed genetic lines grown in 1985, was completed in July 1986. Milestone 3A, laboratory analyses of 2,000 safflower progeny grown in 1986 from the most promising oleic type genetic lines identified in Milestone 3, was completed in May 1987.



## INTRODUCTION

In 1983, in Bozeman, Montana a national conference was held on vegetable oil fuels for northern climates. This gathering identified that safflower seed oil was the Montana crop closest to commercial development for fuel use. Safflower was selected because it can be grown over a large part of Montana, the same farm equipment for growing wheat can be used for safflower production, and safflower has a higher energy yield per energy unit of production than sunflower. Research conducted by the U.S. Department of Energy showed vegetable oil can fuel medium-speed diesel engines used in railroad locomotives and electricity generation. Other research at the University of Idaho identified that safflower oil can be used as an emergency fuel in high-speed diesel farm tractors with minimal processing. This research also identified fewer engine problems in high-speed diesel engines when a high oleic acid safflower was used rather than the commercially available high linoleic safflower oil. It was also shown that safflower oil production could compete with the future price of diesel fuel if oil composition and meal characteristics could be changed to provide an oil with some diesel engine compatibility and a marketable high-protein meal by-product. All this could possibly be done by safflower breeding if certain germplasm characteristics in safflower existed and could be identified.

Safflower germplasm is available and has been evaluated in this project to develop improved oleic type safflower varieties for fuel having high seed oil percentages, high meal protein contents, reduced meal fiber contents, and improved meal protein amino acid compositions for industrial, livestock, or human products. Hybridization and selection of genotypes having the desired gene combinations for these characteristics will greatly enhance the product value of safflower and improve the economics of safflower oil production in Montana for fuel and other co-products.

It may seem surprising, but most of eastern Montana's dryland farms have the potential for producing more oil per acre from currently available safflower varieties than Iowa farms can produce from soybeans. A 30 bushel per acre yield of soybeans will produce about 360 pounds of oil per acre, while a 1200 pound per acre yield of safflower will produce an oil yield of 432 pounds per acre. Safflower oil is largely composed of one fatty acid, either linoleic or oleic, (some 80%) depending upon genotype. The very high content of one fatty acid permits safflower oil to be modified more readily than most vegetable oils for industrial purposes. The fatty acid composition of the high linoleic type and high oleic type of safflower is very stable even when grown in different environments, temperatures, and stress conditions--a quality that is highly desirable when this oil is used as an industrial oil. Additional genes in safflower are available to further modify the proportions of oleic acid, linoleic acid, stearic acid, and palmitic acid and their stability when grown under different environments.

Genes are also available in safflower to reduce the seed coat and pericarp tissue through breeding and selection. The decrease in hull percentage results in a corresponding increase in oil percentage of the seed to 50% or higher and an increase in protein content of the meal up to 35%. The higher

oil yield and higher meal protein value of an improved safflower variety having 50% seed oil content and 35% meal protein will greatly diminish the cost difference between diesel fuels and safflower oil fuels. Genetically improving the amino acid profile of safflower meal protein will further increase its product value and diminish the cost of safflower oil for fuel. Additionally, genes are available in safflower to remove the pigments from the seed coat, pericarp, and other seed tissues of safflower to yield an unusually light colored oil.

Safflower has great potential as an alternate fuel for agricultural production in Montana. In Canada, the surplus of cereal crops resulted in the increased production of rapeseed. Acreage devoted to wheat production in Montana could easily be converted to safflower or other oil crop production for fuel rather than paying subsidies to farmers who do not plant wheat, etc., and would greatly aid the development of vegetable oil crops for fuel, improve crop rotations, and reduce wheat surpluses. The development of safflower oil for fuel would require informational meetings and promotion by the industry, extension services, state and federal research organizations, and farmers who have been successful in growing a vegetable oil fuel.

The procurement of the oilseed laboratory equipment and the production of small quantities of seed of the 4,000+ breeding lines and varieties permitted the simple, rapid, and accurate analyses of safflower oils and co-products for alternate fuel in this research project.

This project's time and resources were devoted to the germplasm evaluation and selection of safflower oil and co-products for fuel and have identified superior oleic type breeding lines that will reduce the cost and enhance the use of safflower oil for fuel in Montana in the event of a fuel shortage and possibly provide energy self-sufficiency for Montana farmers. The highest oleic self progeny among the 2,000 self progeny grown in the 1986 field trial have been grown in the 1987 summer breeding nurseries at the Eastern Agricultural Research Center for seed multiplication, further testing, and varietal development.

## TESTING METHODS, MATERIALS, AND PROCEDURES

The analyses of over 4,000 genetic lines of safflower for various constituents of agronomic interest were performed using the described methods, materials, and procedures. In addition to the 4,000-plus genetic lines, two standard safflower variety samples were included within every group of twenty samples to monitor consistency and possible equipment problems which might lead to erroneous results. Each of the genetic lines and standards was identified by a sample number between 1 and 4880. In most instances, the commercial variety Oker was used as the standard, although other standard varieties were used on occasion.

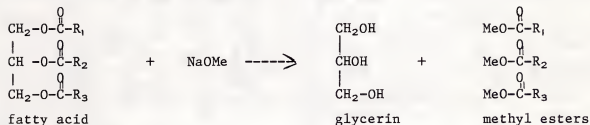
### Oil Content

The seed oil percentage of each line was determined by the Newport Nuclear Magnetic Resonance Analyzer N4000, using a volume of approximately 40 mls of seed which had been dried for at least 4 hours at 60°C in a drying oven. The oil percentages are reported on a dry weight basis. Since this is a non-destructive technique, these same seed samples were then used for the analyses of oil types present, protein, and fiber.

### Oil Type Identification and Relative Percentages

The oil present in the safflower seed was extracted using standard oil seed analyses procedures. The seed was ground in the presence of hexane using a high speed tissue grinder. The hexane containing the oil was then filtered away from the meal using filter paper. The hexane washed meal was dried and saved for protein and fiber determinations.

An aliquot of the hexane containing the safflower oil was then treated with sodium methoxide. This strong base cleaves the C-O bond indicated in



the equation giving glycerin and the methyl esters of the fatty acids. The fatty acids esters were then analyzed via gas-liquid chromatography (GLC) using the Hewlett-Packard 5890-A Gas Chromatograph with 7673-A Auto-sampler and 3392 Integrator. The identities of the peaks were determined by comparing the retention times of the unknown esters in the samples with the retention times of standard samples obtained from commercial sources. The major fatty acid esters found in the samples were the methyl esters of palmitic acid, stearic acid, oleic acid, and linoleic acid. The relative percentages of each of these esters were determined by integrating the area under each peak in the chromatogram. The area under each peak was found to be directly proportional to the percentage of each ester present by using commercial samples

of known percentages. A group of fatty esters were also identified having relative percentages within the oil of between 0.1 and 1.0 percent. These are reported in a section of the Milestone 3 and 3A reports labeled MINOR COMPONENTS. Other peaks were also observed in the chromatogram of less than 0.1% but they were not investigated further.

#### Crude Fiber and Protein

The safflower meal remaining after oil extraction with hexane was washed and dried as previously mentioned. These samples were ground using a 1 mm screen in a Udy Cyclone Grinder. This material was then used to determine the protein percentage and the crude fiber percentage via a Technicon Infra-alyzer 400 (NIR). The instrument was initially calibrated using safflower meal samples which had been analyzed for protein and fiber content by wet chemistry methods (Kjeldahl for protein and AOCS Crude Fiber for fiber). The standard error of estimate for the NIR measurements was on the order of plus or minus 2%. The values reported are the percentages of protein and fiber in the meal and not the whole seed.

It should be noted that the protein determinations via NIR were measured using 5 filters and 6 filters. The two protein values obtained with the 5 filter system and 6 filter system were usually very close. However, with a small number of samples the results obtained were quite different. In these cases the average of the two values was reported. This difference in the values measured in the two different filter systems suggests a unique genetic situation in these genetic lines that should be investigated further.

#### Oil Color Rating

It had initially been intended to perform pigment tissue analyses for the safflower stocks reported in the Milestone 3 report. However, it soon became apparent that, because of the prolonged wet conditions of the fall of 1985, this could not be done. The seeds were stained and discolored sufficiently by the excess moisture so that meaningful differences could not be reliably determined. Instead of pigment tissue analyses, the oil color of the hexane extractions was rated on a scale of 0 to 5 with 0 being colorless and 5 being a dark yellow. Allowances were made for those samples which were low in total oil content. It should be noted that the first 284 samples were not rated because the seed staining problem was not realized at that time.

#### FURTHER TESTING METHODS, MATERIALS, AND PROCEDURES

Based on the results of the analysis of the genetic oil seeds grown in 1985, 2,000 of the most promising progeny lines of oleic type safflower were selected for further study in 1986. The results of this work constituted Milestone 3A.

The safflower seed of interest was produced during both the 1985 and 1986 growing seasons. Each line was grown in a 10-foot row, with 5 plants within the row bagged to prevent pollination and outcrossing by bees and other insects. The remaining plants were allowed to be open-pollinated. The use of the self-pollinated seed from individual plants allows one to select from

the most promising lines of safflower those individual plants which are superior for a particular trait, such as those having the highest percentages of oleic acid in their fatty acid composition. However, because of the limited amount of seed produced from each selfed plant, it was not possible to measure the protein and fiber composition on the meal of the self-pollinated seed. The open-pollinated seed of the genetic line was used for these determinations.

It should be noted that in certain cases there may be less than 5 selfed plants in a particular line. This is because some of the lines did not have enough plants in the 10-foot row to produce 5 plants for selfed-seed production or because no viable seed was produced from certain individual plants. As a result, seed from 1482 lines was available for testing out of the 2,000 progeny initially selected.

#### Seed Oil Content

The oil percentage of each line was determined by the Newport Nuclear Magnetic Resonance Analyzer N-4000, using a volume of approximately 40 mls of seed. This seed had been dried for at least 4 hours at 60°C in a drying oven. The oil percentages are reported on a dry weight basis. It should be noted that the oil content was determined in most cases on the open-pollinated seed, since sufficient quantities of the selfed seed were available on only a few individual plants. In those cases where open-pollinated seed was used, the oil percentage was reported on the line indicating "avg" for the breeding line in the Milestone 3A report. In the few cases where the oil was measured on the self-pollinated seed produced, the oil percentage is reported next to the number indicating that particular plant.

#### Fatty Acid Compositions

The fatty acid composition of the safflower oils from the various breeding lines was determined using a Hewlett-Packard 5890-A Gas Chromatograph with a 7673-A Auto-sampler and 3392 Integrator in a manner similar to that described in Milestone 3. In Milestone 3A, the fatty acid ratios were measured on seed produced from self-pollination. Because of the limited amount of seed produced, and because as much seed as possible was desirable for planting purposes, the fatty acid analyses were determined on one seed from each self-pollinated plant. The relative percentages were reported for each plant along with an average value for the 5 plants from each genetic line. Also, the range from the highest to the lowest percentage for the major fatty acids of each breeding line was reported in Milestone 3A. In those cases where less than 5 plants were available from a breeding line, the average and range were determined on the plants available.

#### Crude Fiber, Protein, and Taste of Safflower Meal

The crude fiber and protein were determined on the meal remaining after oil extraction with hexane. The measurements were made using a Technicon Infra-alyzer 400 (NIR). Because the measurement requires approximately 6-8 grams of meal, seed resulting from open pollination was used in the analyses. The results were reported on the "avg" line of the report for each breeding line.

A crude attempt was made to classify the taste of the safflower meal remaining

after oil extraction. This was done only on the genetic lines which were grown in 1986. The tasting was done by one technician by simply wetting the finger, placing a bit of the meal on the tip, and applying the powder to the tongue. Noticeable differences were readily apparent.

#### Oil Color Ratings

The oil color ratings were made on the neat oil resulting from extraction of the ground seeds with hexane. The hexane was removed by evaporation and the oil placed in small uniform vials. The intensity of the yellow color was visually rated between 1 and 5, with 1 being the lightest and 5 being the darkest.

It should be noted that this was done only on the samples beginning with 6b. The relative values of 0-5 reported for the 5b samples were taken from the Milestone 3 report.

#### Minor Fatty Acid Components

The minor fatty acid components of the safflower oils in Milestone 3A were determined by gas-liquid chromatography. It should be noted that because the fatty acid percentages were determined on only one seed of a particular line, some of the minor components which were detected in Milestone 3 (1985 genetic lines) were below the detection limits of the gas-chromatograph in Milestone 3A (superior progeny lines) when only individual seeds were assayed. The detection limit in Milestone 3 was 0.1%, whereas the detection limit in Milestone 3A was 0.3 to 0.5%.

The fatty acids in the minor component section of Milestone 3 and 3A were as follows:

|                    |        |
|--------------------|--------|
| linolenic acid     | C-18:3 |
| arachidic acid     | C-20:0 |
| 11-eicosenoic acid | C-20:1 |
| behenic acid       | C-22:0 |
| ?                  | C-?    |
| lignoceric acid    | C-24:0 |
| nervonic acid      | C-24:1 |

## RESULTS AND DISCUSSION

### Seed Sample Production in 1985 Season

Sufficient seed of over 4,000 genetic lines for laboratory testing was obtained during the 1985 safflower growing season. The planting of the genetic lines was accomplished on May 8, 1985 and the harvest was completed in mid-November 1985. Precipitation in May was 1.19 inches with a mean temperature of 62.2°F (7.2° above normal). June precipitation of 0.50 inch was much below the average June precipitation of 2.81 inches. The first half of July was very hot and no precipitation was received until July 16th. Because of the dry conditions, the breeding nursery received two sprinkler irrigations of 1 1/2 inches of water each on June 19 and July 9, 1985. Rains started July 29th, continued through August, and extended into October.

The excessive rains (late in the season) caused considerable weathering of the safflower genetic lines. A 16-inch snowfall received on October 7th further delayed the harvest of the safflower genetic lines until October 16th. Bagged plants of each genetic line were clipped and stored inside a building for threshing selfed seed to serve as a seed source for further testing and selection and to plant future small test plots. This harvest was completed during the October 16th-November 15th, 1985 period. Open pollinated plants were also cut and threshed during this period to obtain the seed samples needed for laboratory testing. Winter arrived on November 18, 1985. Fortunately, field harvest of the safflower genetic lines was completed on November 15, 1985.

The open-pollinated seed of all genetic lines was cleaned and available for analyses in December 1985. The bagged plants were threshed and the self seed from individual plants of each genetic line were cleaned, identified, and placed in coin envelopes in metal storage boxes for future use. This task was completed in March 1986.

### Oleic Safflower Preliminary Performance Tests at Various Montana Sites

Twenty varieties of safflower varying in oil type characteristics were grown at six Montana State University research centers in Montana during the summer of 1985. The Research Centers and locations were Eastern (Sidney), Southern (Huntley), Central (Moccasin), Northern (Havre), Western Triangle (Conrad), and Northwestern (Kalispell). The test weight, oil content, yield, fatty acid composition, meal composition, and oil color were analyzed for each site. The safflower failed to mature completely at the Conrad, Moccasin, and Kalispell sites. These locations would not be desirable test locations for safflower varieties because of their high elevation and/or insufficient growing degree units to consistently produce mature safflower. The other test locations at Sidney, Havre, and Huntley were very suitable for safflower production. The Sidney irrigated site is ideal for testing of safflower varieties under high disease conditions. The Huntley irrigated site produced seed highest in oleic acid regardless of variety, presumably due to the warmer temperatures, ample moisture conditions, and the low incidence of disease that occurred at this site in 1985. The Sidney and Havre dryland sites received much-below-normal precipitation during the growing season with

yields only in the 107-630 pounds per acre range. However, normal yields for these locations are 800-1200 pounds per acre.

#### Seed Laboratory Analyses of Oil Content of the 1985 Genetic Lines by Use of Nuclear Magnetic Resonance

The analyses of oil content on all the safflower genetic lines and commercial safflower varieties were performed by use of a Newport Nuclear Magnetic Resonance Oil Analyzer N4000 and reported on a dry weight basis. The oil contents of these genetic lines ranged from a low of 0% for very late maturing lines that failed to produce mature seed to 50.0%. A seed oil content of 38% or higher would be acceptable for commercial production but, of course, higher seed oil contents are highly desirable. The results of this project showed that many of the safflower genetic lines were high in seed oil content (Appendix B).

#### Fatty Acid Laboratory Analyses on the 1985 Genetic Lines by Use of Gas Chromatography

A Hewlett-Packard 5890A Gas Chromatograph with 7673-A Auto-sampler and 3392 Integrator was utilized to identify the kind and quantity of fatty acids for the oils of the 1985 genetic lines and varieties. Even though a precision oilseed refractometer was available to determine the refractive index and iodine number values of the safflower genetic stocks and varieties, these determinations were not made because of the availability and use of the Hewlett-Packard Gas Chromatograph. Fatty acid analyses provided us with a much more accurate measurement of fatty acid composition than refractive index and iodine value measurements. The major fatty acids identified in the genetic lines were linoleic acid (C18:2), oleic acid (C18:1), palmitic acid (C16:0), and stearic acid (C18:0). Minor component fatty acids (less than 1% of the total fatty acid composition) included linolenic (C18:3), arachidic (C20:0), 11-eicosenoic acid (C20:1), behenic acid (C22:0), lignoceric acid (C24:0), and nervonic acid (C24:1). The results from the fatty acid analyses of the 1985 genetic stocks showed that the percentage of oleic acid ranged from a high of 80.8% to a low of 5.4%. Superior progeny lines for oleic acid content were identified from the 1985 genetic lines (Appendix A). From the superior 1985 genetic lines, seed of 1,482 progeny were grown in 1986 and analyzed in Milestone 3A to permit further selection for oleic acid among the self progeny of the high oleic genetic lines. Many of these self progeny were superior in oleic acid content than their 1985 genetic lines (Appendix I). Those progeny having an oleic fatty acid level of 80% or higher were included in the 1987 MSU Eastern Agricultural Research Center safflower summer breeding nursery for further evaluation, selection, and seed production.

#### Meal Protein Content Analyses of the 1985 Genetic Lines by Use of Near Infrared Reflectance

The analyses of meal protein of the 1985 genetic lines and varieties were performed by use of the near infrared reflectance Technicon Infra-alyzer 400. The meal protein values of the genetic lines ranged from 12.9 to 47.7%. The commercially grown varieties S-541, S-208, Oker, and Hartman at the same site had meal protein values of 28.1, 24.3, 33.6, and 24.9%, respectively.

Oker has the highest meal protein content of available commercial varieties. Many of the genetic lines were higher in meal protein than Oker. The high meal protein genetic lines are listed in Appendix C. A small number of the genetic lines appeared to have different protein(s) and warrant more detailed protein analyses. These genetic lines are 85B2049, 85B2530, 85B3365, 85B3662, 85B3670, and 85B3945.

#### Meal Fiber Content Analyses of the 1985 Genetic Lines by Use of Near Infrared Reflectance

The analyses of meal fiber content of the 1985 genetic lines and varieties were performed by use of the near infrared reflectance Infra-alyzer 400. The meal fiber values of the genetic lines ranged from 10.5 to 54.2%. The commercially grown varieties S-541, S-208, Oker, and Hartman at the same site had meal fiber values of 35.2, 38.8, 28.4, and 38.8, respectively. Oker has the lowest meal fiber content of available commercial varieties. Many of the genetic lines were lower in meal fiber than Oker. The low meal fiber lines are presented in Appendix D.

#### Lysine and Methionine Amino Acid Analyses of the 1985 Genetic Lines by Use of Bio-assay

The analyses of the amino acids lysine and methionine were performed by a bio-assay of the lines using amino-acid-sensitive strains of *Pediococcus cerevisiae* bacteria. The bacterial growth was proportionate to the amount of lysine or methionine present in the seed of each safflower genetic line. The Hartman variety of safflower was used as a standard for comparative purposes. Thirty-nine safflower genetic lines were identified as high lysine lines and 89 safflower genetic lines were identified as high methionine lines (Appendix J). Twenty safflower genetic lines were high in both lysine and methionine (Appendix J). All of these high lysine and/or methionine genetic lines warrant further amino acid analyses by high performance liquid chromatography.

#### Oil Color Ratings of the 1985 Genetic Lines

It was initially intended to perform pigment tissue analyses for the safflower genetic lines by microscopic examination of imbedded, excised seeds. However, the seeds were stained and discolored by the prolonged wet conditions that occurred in the fall of 1985 so that meaningful differences in pigmentation could not be reliably determined by microscopic examination of pigment tissues. Instead, the oil color of the hexane oil extractions was rated on a scale of 0 to 5 with 0 being colorless and 5 being dark yellow to identify genetic lines low in pigmentation. Many of the genetic lines were rated lighter in oil color than the commercial varieties currently grown. The low oil color, high oleic genetic lines are listed in Appendix H.

#### Evaluation of Test Weight, Disease Resistance, Plant Height, Insect Damage, Maturity, Seed Yield, Oil Yield, and Other Agronomic Traits for the 1985 Genetic Lines

The agronomic field data for the over 4,000 safflower genetic lines that were planted, grown, and harvested during the 1985 field growing season were reported in Milestone 2. The seed oil content for each of these oilseed stocks

was reported in Milestone 3.

### Conclusions

The top 1985 safflower genetic lines were identified in Milestone 3 for each of the following seed, meal, oil, and other seed properties: high oleic fatty acid in its oil, high seed oil content, high meal protein content, low meal fiber content, low oil color rating, high seed oil content/high oleic lines, high meal protein content/high oleic lines, low meal fiber content/high oleic lines, low color rating/high oleic lines, high lysine lines, high methionine lines and high lysine/methionine. In Milestone 3A, the superior oleic progeny of the 1985 high oleic genetic lines were identified. These genetic lines and superior progeny are also listed in the appendices. Of particular interest is the finding that the oleic acid content of 135 self progeny of the high oleic genetic lines were equal to or higher in oleic acid content than the highest oleic acid genetic line (80.8%) identified from the 1985 genetic lines. The information and data obtained from the 1985 genetic lines and the self progeny of the superior 1985 genetic lines for oleic acid have been sorted, analyzed, and stored on discs by use of an IBM Personal Computer AT and the Lotus 1-2-3 information management program. The remaining seed of the 1985 genetic lines and superior self progeny was inventoried and placed in seed storage for future development work to establish safflower oilseed as a fuel resource. Those progeny having an oleic fatty acid level of 80% or higher were included in the 1987 MSU Eastern Agricultural Research Center summer safflower breeding nurseries for further agronomic evaluation and seed production.

## ECONOMICS

Fuel safflower oil can compete with future diesel oil prices if the oil and meal by-product are both profitably marketable. The break-even cost of producing safflower for fuel in 1982 was estimated by the Development Planning and Research Associates, Inc. (Manhattan, Kansas for DNRC) to be \$2.47 per gallon (Table 1, top line, 1982 production costs). The assumptions made were that seed oil content was 36%, the 19% protein meal price was \$60 per ton, and the processing margin was \$20 per ton. No distinction was made between processing costs for food grade oil and fuel use, which probably overstated the processing cost for fuel use. It was also assumed in the 1982 analysis that all economic benefits accrue the cost (reduction) of oil.

The cost of safflower production was updated from the 1982 cost of \$2.47 per gallon to 1987 costs using actual costs when available from agricultural, industrial, and government sources (Appendix K). The per acre cost of safflower production shows that fossil fuels account for 19.7% of the production cost in 1987 (24% in 1982) through the use of fuel, lube oil, fertilizer, herbicides, and insecticides. Fossil fuels are a whopping 46% of the variable cost. On an energy-in and energy-out production basis, 6.9 Btu's of safflower oil can be produced by a Btu of No. 2 diesel fuel (Appendix K). This shows that safflower oil could survive as an emergency fuel because more energy is produced from safflower than is used in its production.

Emergency situations aside, fuel safflower will be successful only if it is economically viable. The break-even cost of producing safflower was calculated for several genetic lines discovered in this project using the same methodology developed in 1982 with both 1982 and 1987 costs. The results of that investigation, Table 1, identify that the cost of using safflower as a fuel could be significantly reduced by product enhancements through safflower breeding and genetic manipulation. Seed yields are estimated on the percentage of fiber in the meal. Each percent decrease in fiber content corresponds to a 1% seed yield decrease, largely due to the reduced hull and, thus, increase in oil or protein content. Based on industry input, safflower meal value increases in the analysis by \$5 per ton for each 1% increase in protein over 22%. The analysis uses a constant oil processing cost of \$0.22 per gallon because industrial data isn't available to correlate processing cost with oil content. The cost is still a good ball park figure in 1987, according to industrial representatives. Other production costs, such as labor and overhead, were adjusted from 1982 costs based on the cost of living index.

Table 1 shows the seed oil, meal protein, and meal fiber contents, seed yield, oil and meal yield, meal price and value, and the break-even oil price for 7 of the 6,000 different safflower genetic lines analyzed in this project. The analysis is limited to high-oleic acid lines. The analysis illustrates that the break-even cost of safflower oil of some existing safflower lines can compete with diesel fuel if land rental and management costs are removed from production costs. This would represent a farmer who owns the land and does his own farming, including hired help, rather than renting land and contracting out the farming. The far right column on Table 1 shows the break-even production cost of safflower oil based on variable costs only, as would be the case if comparing it to other crops with similar fixed costs, or an emergency situation.

Table 1. Seed, Oil, and Meal Yields, and Break-even Price for Seven Safflower Genetic Oilseed Stocks

| Oil Cont.<br>Whole<br>Seed Dry<br>Basis (1) | Protein<br>Wt %<br>of Meal<br>(2) | Fiber<br>Wt %<br>of Meal<br>(2) | Predicted<br>Seed<br>Yield<br>Lbs/Acre | Oil<br>Yield<br>Gal/A<br>(3) | Meal<br>Yield<br>Lbs/A<br>(4) | Meal<br>Price<br>\$/Ton | Meal<br>Value<br>\$/Acre | Break-even Price of Safflower Oil (5) |                            |                                       |                                      |
|---------------------------------------------|-----------------------------------|---------------------------------|----------------------------------------|------------------------------|-------------------------------|-------------------------|--------------------------|---------------------------------------|----------------------------|---------------------------------------|--------------------------------------|
|                                             |                                   |                                 |                                        |                              |                               |                         |                          | 1982<br>Prod Cost<br>Basis            | 1987<br>Prod Cost<br>Basis | 1987 Cost<br>w/o Land<br>Rent & Manmt | 1987 Basis<br>Variable<br>Costs Only |
| 36.0%                                       | 22.0%                             | 35.0%                           | 1290                                   | 59.4                         | 793                           | 60                      | \$23.78                  | \$2.48                                | \$1.92                     | \$1.19                                | \$0.71                               |
| 38.0%                                       | 32.0%                             | 32.0%                           | 1251                                   | 60.8                         | 745                           | 110                     | \$40.96                  | \$2.14                                | \$1.59                     | \$0.88                                | \$0.42                               |
| 40.0%                                       | 34.0%                             | 29.0%                           | 1213                                   | 62.0                         | 698                           | 120                     | \$41.91                  | \$2.09                                | \$1.55                     | \$0.85                                | \$0.40                               |
| 42.0%                                       | 36.0%                             | 26.0%                           | 1174                                   | 63.1                         | 654                           | 130                     | \$42.49                  | \$2.05                                | \$1.52                     | \$0.82                                | \$0.39                               |
| 44.0%                                       | 40.0%                             | 22.0%                           | 1122                                   | 63.2                         | 603                           | 150                     | \$45.25                  | \$2.00                                | \$1.48                     | \$0.78                                | \$0.34                               |
| 47.0%                                       | 44.0%                             | 18.0%                           | 1071                                   | 64.4                         | 545                           | 170                     | \$46.31                  | \$1.95                                | \$1.44                     | \$0.75                                | \$0.32                               |
| 50.4%                                       | 36.4%                             | 27.2%                           | 1189                                   | 76.7                         | 566                           | 132                     | \$37.38                  | \$1.79                                | \$1.36                     | \$0.74                                | \$0.42                               |

## NOTES

- (1) Oil content reported on a dry basis, average moisture is 4 to 8%.
- (2) Meal protein and fiber values are the weight percentages in the meal, not the whole seed.
- (3) Oil extraction is assumed to recover 98.5% of total oil.  
One gallon is 7.7 lbs., or (lbs/acre x % oil x .985)/7.7
- (4) Meal yield = [(lbs seed yield) x (1 - % seed oil)] x .96 dry/wet meal.
- (5) Break-even oil price = [(Production cost - meal value)/oil yield] + process cost.  
Production cost for 1982 = \$157.93, for 1987 = \$124.56, 1987 variable cost = \$53.04/acre.  
Processing cost, 1982 = \$0.22/gal or \$20/ton.  
No processing cost reduction figured for higher oil content oil seed.

The analysis also shows that an increase in seed oil content results in a reduction in seed hull and seed yield per acre. The added oil and meal value would need to be reflected in new marketing methods, or the producer might suffer a loss due to decreased production.

As Table 1 shows, the break-even cost of producing safflower for fuel is significantly reduced by increasing the oil yield per acre, and especially by enhancing the meal by-product value. This can be done through selective safflower breeding and genetics since all the numbers are from existing genetic lines tested. Additional genetic improvement in the amino acid profile of safflower meal, improved fatty acid composition, elimination of the bitter taste of the meal for livestock, and other desirable co-product improvements would further improve the economics of fuel safflower oil, as well as safflower for food use.

#### FUTURE DEVELOPMENT WORK TO ESTABLISH SAFFLOWER OILSEED AS A FUEL RESOURCE

Several surmountable agronomic hurdles exist before safflower oil fuel use is economical. The question of growing food or fuel will again surface because the medical profession now recommends monounsaturated fatty acids, found in olive oil and high oleic safflower oil, as a means of lowering levels of detrimental low-density lipoprotein (LDL) cholesterol in the blood without changing the levels of beneficial high-density lipoprotein (HDL) cholesterol in the blood. Polyunsaturated oils decrease the levels of both LDL and HDL but have been reported to be linked to increased risk of cancer. This recommendation will affect the markets for oleic safflower oil which are just now developing. Also, existing combines are unable to harvest 50% oil seed having reduced hull thickness without damaging the seed. At least one combine manufacturer claims that one of their new model combines will harvest a high oil content crop without damage. The problem remaining is to make available a commercial high oleic-high oil yielding breed of seed for production in Montana from this plant species which is native to India and other Middle East countries. The following steps are suggested:

1. Produce larger seed quantities of the most promising genetic lines for yield and agronomic performance evaluation at different locations in Montana for laboratory testing of fuel quality and for limited nutritional studies of the safflower by-products. Emphasis should be placed on identifying those genetic lines superior in yielding ability and disease resistance for commercial production in Montana. A minimum of 2 pounds of seed of each genetic line would be required for field performance testing. Laboratory analyses would be performed on seed produced from the field performance tests.
2. A limited number of the most promising genetic lines (5-10) should undergo an initial seed increase for pure seed multiplication for possible variety release under a certified seed program. The desirable seed stocks for high oleic acid, high meal protein, high oil, low oil color (reduced pigmentation) would be continued in the safflower breeding program for further selection and breeding for improved seed properties and disease resistance.
3. Incorporate by breeding methods disease resistance into desirable seed stocks having high oleic acid, high meal protein, high oil, high oil color

quality (reduced pigmentation) and other desirable seed properties. Desirable seed stocks would be hybridized to disease resistant commercial varieties and selection for disease resistance and desirable seed properties would be practiced in the  $F_2$ ,  $F_3$ , and  $F_4$  generations. All the segregating genetic lines would be subjected to Alternaria leaf spot, Pseudomonas bacterial blight, and Sclerotinia head rot at Sidney, Montana and evaluated for seed properties, maturity, oil content, and resistance to Alternaria leaf spot, Pseudomonas bacterial blight, rust, and head rot. Surviving selections will be placed in yield trials in the  $F_4$  generation where evaluation and selection for yielding ability, disease resistance, oil content, high oleic acid, and other desirable seed and plant characteristics will continue.

4. Oilseed yield nurseries will be grown at cooperating research centers in Montana. All nurseries will be grown in approved experimental designs with not less than 3 replications. Observations to be obtained will include date of planting, row spacing, rate of seeding, depth of seeding, previous crop, fertilizer rate, percent stand, date of first flower, diseases present, level of disease infection, plant height, date of harvest, shattering percentage, test weight, seed yield per plot, and any other worthy observations. The Eastern Agricultural Research Center will obtain seed samples for appropriate oil quality and seed properties analyses to include fatty acid analyses, oil content, meal protein and fiber analyses, meal taste, and oil color rating. Seed of any superior safflower variety for fuel use would be increased for variety release and commercial production in Montana.

5. Add additional oilseed laboratory equipment to the Eastern Agricultural Research Center's safflower breeding and research program facilities to permit the simple, rapid, and accurate analyses of safflower oils and co-products for amino acid levels in meal protein, bitter flavor compounds, seed coat interhull and phytomelanin pigments, chlorophyll content, carotene content, oil color and crude mechanical oil extractions.

| <u>Safflower Assay</u>                           | <u>Equipment Required</u>                    | <u>Estimated Cost</u> |
|--------------------------------------------------|----------------------------------------------|-----------------------|
| 1. Amino acid levels in meal protein             | High performance liquid chromatograph (HPLC) | \$45,700              |
| 2. Bitter flavor compounds of meal               | HPLC                                         | see above             |
| 3. Seed coat interhull and phytomelanin pigments | HPLC                                         | see above             |
| 4. Chlorophyll and carotene content              | Lovibond tintometer                          | 7,000                 |
| 5. Oil color                                     | UV-Visible spectrophotometer                 | 8,000                 |
| 6. Crude safflower oil extraction                | Hydraulic press<br>(temperature controlled)  | 4,000 <sup>3</sup>    |
| Total Equipment Cost . . .                       |                                              | \$64,700              |

## GRANT ADMINISTRATION

The original RAE-85-1054 project was to analyze seeds of over 4,000 genetic lines grown in 1985. Additional funding in the amount of \$16,800 was provided for the seed analyses of self progeny of the superior oleic genetic lines identified among the 1985 genetic lines. The funding for the analyses of self progeny of the superior oleic genetic lines was a result of a combination of circumstances, including Eastern Agricultural Research Center budget cuts, the deterioration of 1985 seed as a result of prolonged wet conditions during seed maturation and harvest, and the availability of DNRC funds.

### Budget Summary (through December 1987)

|                         |                     |
|-------------------------|---------------------|
| Salaries                | \$ 42,808.49        |
| Benefits                | 5,682.50            |
| Repairs and maintenance | 1,188.49            |
| Travel                  | 925.93              |
| Contracted services     | 11,129.30           |
| Supplies                | 24,798.02           |
| Rent                    | 127.50              |
| Major equipment         | 101,690.24          |
| Other equipment         | 1,688.67            |
| Indirect charges        | 17,132.71           |
|                         | <u>\$207,171.85</u> |

Additional indirect costs, video tape production expenses,  
and other costs . . . . . \$9,792.15

### Funds From Other Sources

|                                                                                                                         |          |
|-------------------------------------------------------------------------------------------------------------------------|----------|
| Proposer contribution, Montana Agricultural Experiment<br>Station, Montana State University, Bozeman, Montana . . . . . | \$73,240 |
| Continental Grain Co., Culbertson, MT . . . . .                                                                         | 16,000   |
| Northern Plains Safflower Growers Ass'n., Sidney, MT . . . . .                                                          | 2,000    |



**HIGH OLEIC  
LINES**



| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 212      | 47.0  | 3.6        | 1.3       | 80.8    | 12.4       | 38.9      | 19.1    |
| 2987     | 42.0  | 4.0        | 1.6       | 79.5    | 16.1       |           |         |
| 211      | 46.1  | 3.5        | 1.2       | 79.5    | 13.9       | 40.1      | 18.6    |
| 3932     | 50.4  | 3.7        | 1.2       | 79.0    | 15.0       | 38.4      | 23.2    |
| 3044     | 43.7  | 3.8        | 1.6       | 78.4    | 17.6       | 24.6      | 37.5    |
| 4547     | 44.8  | 3.6        | 1.2       | 78.4    | 14.9       | 29.2      | 31.0    |
| 4875     | 47.8  | 3.5        | 1.4       | 78.3    | 15.3       | 34.8      | 27.9    |
| 1332     | 46.5  | 3.9        | 1.4       | 78.2    | 14.7       | 36.9      | 27.6    |
| 3342     | 45.3  | 3.5        | 1.6       | 77.7    | 15.5       | 28.8      | 35.6    |
| 758      | 41.7  | 3.7        | 1.2       | 77.6    | 15.8       |           |         |
| 2246     | 46.5  | 3.9        | 1.4       | 77.4    | 15.6       | 34.3      | 26.6    |
| 3338     | 44.0  | 3.5        | 1.5       | 77.2    | 16.2       | 29.2      | 34.7    |
| 455      | 39.4  | 3.8        |           | 77.2    | 17.2       | 27.4      | 37.6    |
| 3049     | 40.7  | 4.3        | 1.6       | 77.1    | 15.4       | 26.1      | 39.3    |
| 3051     | 42.7  | 4.0        | 1.5       | 77.0    | 16.0       | 24.6      | 36.1    |
| 2245     | 42.3  | 4.0        | 1.3       | 76.9    | 16.2       | 29.1      | 33.8    |
| 2985     | 47.0  | 4.1        | 1.4       | 76.9    | 15.9       | 40.0      | 23.1    |
| 746      | 40.1  | 3.8        | 1.4       | 76.8    | 16.4       | 23.3      | 40.3    |
| 2095     | 41.7  | 4.5        | 1.3       | 76.8    | 15.8       | 25.8      | 33.7    |
| 2084     | 41.7  | 4.3        | 1.3       | 76.7    | 16.0       | 26.1      | 33.7    |
| 3930     | 50.2  | 3.9        | 1.3       | 76.4    | 16.9       | 40.8      | 18.9    |
| 3337     | 41.1  | 3.5        | 1.5       | 76.4    | 17.0       | 31.2      | 35.1    |
| 4005     | 42.5  | 3.7        | 2.0       | 76.4    | 16.2       | 29.3      | 38.3    |
| 2244     | 41.1  | 3.9        | 1.2       | 76.4    | 16.9       | 26.6      | 35.7    |
| 3048     | 42.8  | 4.0        | 1.5       | 76.3    | 16.6       | 20.7      | 41.3    |
| 2247     | 45.5  | 3.9        | 1.3       | 76.3    | 16.8       | 33.6      | 28.1    |
| 3010     | 47.9  | 3.9        | 1.7       | 76.2    | 16.6       | 35.0      | 33.7    |
| 3016     | 45.1  | 4.2        | 1.8       | 76.2    | 16.2       | 37.7      | 25.9    |
| 863      | 35.7  | 4.1        | 1.2       | 76.2    | 16.9       | 38.4      | 21.4    |
| 2034     | 37.0  | 3.8        | 1.5       | 76.2    | 16.9       | 26.9      | 35.1    |
| 2085     | 42.1  | 4.4        | 1.3       | 76.1    | 16.8       | 27.6      | 30.7    |
| 2031     | 38.5  | 3.8        | 1.5       | 76.0    | 16.9       | 27.6      | 32.7    |
| 3052     | 45.2  | 4.0        | 1.5       | 75.9    | 17.0       | 28.0      | 35.9    |
| 2986     | 44.1  | 4.2        | 1.3       | 75.9    | 16.7       | 37.2      | 23.9    |
| 2088     | 43.3  | 4.4        | 1.3       | 75.9    | 16.8       | 27.6      | 32.5    |
| 3341     | 43.0  | 3.7        | 1.6       | 75.9    | 17.2       | 28.3      | 36.5    |
| 3014     | 46.2  | 4.1        | 1.7       | 75.9    | 16.8       | 35.6      | 28.8    |
| 4004     | 42.4  | 4.0        | 1.9       | 75.8    | 16.6       | 30.0      | 36.9    |
| 4811     | 39.3  | 4.0        | 1.7       | 75.7    | 16.7       | 22.8      | 44.1    |
| 3183     | 41.4  | 4.1        | 1.6       | 75.7    | 17.0       | 23.8      | 37.4    |
| 2038     | 37.9  | 3.9        | 1.6       | 75.6    | 17.1       | 27.0      | 35.2    |
| 3042     | 43.1  | 4.0        | 1.6       | 75.6    | 17.1       | 23.7      | 38.9    |
| 1409     | 44.8  | 4.2        | 1.5       | 75.5    | 17.3       | 41.7      | 15.7    |
| 3931     | 48.8  | 4.2        | 1.4       | 75.5    | 17.4       | 41.7      | 20.2    |
| 2033     | 37.8  | 3.9        | 1.5       | 75.5    | 17.4       | 25.8      | 35.3    |
| 3987     | 38.9  | 4.2        | 1.6       | 75.5    | 17.1       | 24.3      | 36.7    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 2094     | 42.0  | 4.4        | 1.2       | 75.4    | 16.9       | 28.0      | 30.7    |
| 2988     | 39.0  | 4.1        | 1.9       | 75.4    | 16.8       | 30.0      | 36.3    |
| 2089     | 41.9  | 4.4        | 1.3       | 75.3    | 17.4       | 26.0      | 34.3    |
| 2090     | 39.6  | 4.4        | 1.4       | 75.3    | 17.1       | 24.9      | 34.1    |
| 332      | 36.9  | 3.9        | 1.2       | 75.2    | 18.0       | 24.8      | 37.1    |
| 3011     | 45.9  | 4.0        | 1.7       | 75.2    | 17.5       | 30.3      | 34.5    |
| 4752     | 45.1  | 4.1        | 1.5       | 75.2    | 17.6       | 24.2      | 40.2    |
| 2093     | 39.8  | 4.4        | 1.3       | 75.1    | 17.3       | 26.9      | 33.1    |
| 2091     | 39.8  | 4.5        | 1.3       | 75.1    | 17.2       | 24.7      | 35.4    |
| 2398     | 40.7  | 3.7        | 1.4       | 75.1    | 18.0       | 38.3      | 24.3    |
| 2248     | 44.4  | 3.9        | 1.3       | 75.1    | 17.8       | 35.5      | 26.3    |
| 3043     | 44.0  | 3.9        | 1.6       | 75.0    | 17.9       | 22.3      | 38.1    |
| 2963     | 42.7  | 3.6        | 1.1       | 75.0    | 18.8       | 29.1      | 33.2    |
| 2429     | 44.0  | 4.2        | 1.2       | 74.9    | 18.1       | 25.3      | 36.8    |
| 452      | 39.5  | 3.9        | 1.3       | 74.9    | 18.1       | 27.6      | 34.4    |
| 451      | 39.2  | 3.8        | 1.3       | 74.9    | 18.4       | 23.1      | 38.6    |
| 450      | 41.3  | 3.8        | 1.3       | 74.8    | 18.4       | 29.8      | 35.0    |
| 3184     | 41.0  | 4.2        | 1.7       | 74.8    | 17.7       | 24.0      | 38.6    |
| 454      | 38.8  | 4.3        | 1.5       | 74.8    | 17.9       | 28.4      | 34.3    |
| 4513     | 38.7  | 4.0        | 1.4       | 74.8    | 18.3       | 30.0      | 37.8    |
| 471      | 46.1  | 4.1        | 1.5       | 74.7    | 18.2       | 40.1      | 22.5    |
| 2036     | 37.1  | 3.9        | 1.6       | 74.7    | 18.2       | 25.9      | 37.1    |
| 2092     | 40.2  | 4.5        | 1.4       | 74.7    | 17.3       | 27.4      | 35.0    |
| 2028     | 37.4  | 3.8        | 1.6       | 74.7    | 18.2       | 24.2      | 31.5    |
| 2243     | 44.2  | 3.9        | 1.4       | 74.7    | 18.3       | 27.0      | 34.3    |
| 2292     | 39.1  | 3.9        | 1.3       | 74.7    | 18.6       | 33.8      | 32.9    |
| 4003     | 43.8  | 3.9        | 1.9       | 74.6    | 17.8       | 34.3      | 30.4    |
| 2042     | 37.7  | 3.7        | 1.6       | 74.6    | 18.5       | 28.9      | 35.5    |
| 1434     | 42.8  | 4.1        | 1.3       | 74.6    | 18.3       | 24.8      | 35.5    |
| 2984     | 48.3  | 4.3        | 1.5       | 74.6    | 18.0       | 35.4      | 28.1    |
| 3998     | 40.3  | 4.4        | 1.5       | 74.6    | 17.7       | 26.6      | 37.9    |
| 2428     | 42.4  | 4.2        | 1.1       | 74.6    | 18.5       | 24.2      | 37.9    |
| 3015     | 45.3  | 4.2        | 1.9       | 74.6    | 17.7       | 37.3      | 25.1    |
| 4734     | 43.0  | 4.4        | 1.4       | 74.6    | 17.9       | 27.8      | 37.1    |
| 2958     | 38.9  | 3.4        | 1.3       | 74.6    | 19.2       | 26.4      | 37.1    |
| 4798     | 43.0  | 4.3        | 1.6       | 74.5    | 18.0       | 26.7      | 39.4    |
| 2887     | 41.7  | 4.1        | 1.3       | 74.5    | 18.4       | 29.8      | 32.7    |
| 2035     | 37.6  | 3.9        | 1.5       | 74.5    | 18.5       | 26.0      | 33.7    |
| 3332     | 40.7  | 3.9        | 1.2       | 74.5    | 19.0       | 25.3      | 35.4    |
| 3336     | 39.9  | 3.7        | 1.3       | 74.5    | 19.1       | 24.1      | 37.3    |
| 1450     | 39.1  | 4.4        | 1.3       | 74.4    | 18.2       | 22.1      | 40.5    |
| 2998     | 40.7  | 4.1        | 1.6       | 74.4    | 18.3       | 23.9      | 38.5    |
| 2083     | 39.7  | 4.5        | 1.4       | 74.4    | 18.1       | 26.0      | 34.1    |
| 4510     | 41.2  | 4.0        | 1.3       | 74.4    | 18.7       | 25.5      | 37.0    |
| 2947     | 35.0  | 4.5        | 1.5       | 74.4    | 18.1       | 25.5      | 38.4    |
| 3334     | 41.4  | 3.8        | 1.3       | 74.3    | 19.1       | 27.7      | 34.8    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 3335     | 40.3  | 3.9        | 1.3       | 74.3    | 19.1       | 26.0      | 34.1    |
| 2894     | 40.7  | 4.1        | 1.3       | 74.3    | 20.8       | 28.2      | 37.3    |
| 3984     | 43.9  | 3.8        | 1.6       | 74.2    | 18.6       | 30.1      | 34.4    |
| 1736     | 41.3  | 4.1        | 1.2       | 74.2    | 18.8       | 37.2      | 24.4    |
| 2304     | 37.6  | 3.8        | 1.3       | 74.2    | 19.0       | 29.8      | 33.5    |
| 1327     | 48.8  | 4.2        | 1.3       | 74.2    | 18.6       | 36.8      | 27.1    |
| 2883     | 44.1  | 4.1        | 1.4       | 74.2    | 18.7       | 30.0      | 32.4    |
| 2890     | 42.0  | 4.0        | 1.2       | 74.2    | 19.0       | 27.4      | 34.5    |
| 4148     | 48.2  | 4.4        | 1.3       | 74.1    | 18.5       | 37.3      | 25.5    |
| 4514     | 39.4  | 4.0        | 1.2       | 74.1    | 19.0       | 28.6      | 39.1    |
| 866      | 38.7  | 3.9        | 1.2       | 74.1    | 19.2       | 35.9      | 25.6    |
| 457      | 38.9  | 3.9        | 1.5       | 74.1    | 18.7       | 27.2      | 37.1    |
| 2431     | 40.6  | 4.4        | 1.3       | 74.1    | 18.5       | 23.6      | 37.6    |
| 2044     | 38.7  | 3.8        | 1.6       | 74.1    | 18.6       | 27.2      | 37.0    |
| 2045     | 38.3  | 3.8        | 1.6       | 74.1    | 18.6       | 27.7      | 34.1    |
| 3985     | 41.5  | 3.7        | 1.9       | 74.0    | 18.5       | 31.4      | 33.9    |
| 470      | 45.3  | 4.0        | 1.4       | 74.0    | 18.9       | 39.5      | 25.4    |
| 647      | 47.4  | 4.0        | 1.3       | 74.0    | 19.3       | 37.7      | 22.7    |
| 2962     | 44.8  | 3.7        | 1.3       | 74.0    | 19.5       | 31.2      | 30.2    |
| 2436     | 38.5  | 4.5        | 1.6       | 74.0    | 18.1       | 23.3      | 37.1    |
| 4549     | 44.9  | 4.4        | 1.4       | 74.0    | 18.8       | 26.2      | 36.0    |
| 2029     | 38.3  | 3.9        | 1.6       | 73.9    | 18.8       | 24.9      | 36.0    |
| 1430     | 39.4  | 4.3        | 1.2       | 73.9    | 19.0       | 25.3      | 39.3    |
| 2046     | 36.6  | 3.8        | 1.7       | 73.9    | 18.8       | 25.3      | 33.9    |
| 3333     | 41.3  | 3.9        | 1.3       | 73.9    | 19.5       | 28.2      | 35.2    |
| 2037     | 37.1  | 3.9        | 1.5       | 73.9    | 18.9       | 26.3      | 37.0    |
| 2032     | 36.8  | 3.8        | 1.7       | 73.8    | 18.7       | 26.1      | 36.1    |
| 1432     | 39.9  | 4.1        | 1.3       | 73.8    | 19.1       |           |         |
| 2916     | 38.3  | 3.8        | 1.2       | 73.8    | 19.4       | 25.5      | 38.8    |
| 1762     | 40.6  | 3.9        | 1.0       | 73.8    | 20.0       | 28.5      | 33.8    |
| 2889     | 41.7  | 4.1        | 1.2       | 73.8    | 19.3       | 29.0      | 33.6    |
| 2204     | 37.0  | 4.1        | 1.7       | 73.7    | 18.6       | 26.2      | 39.4    |
| 4355     | 46.7  | 4.3        | 1.4       | 73.7    | 19.1       | 28.9      | 32.0    |
| 2977     | 44.2  | 4.1        | 1.6       | 73.7    | 18.8       | 33.3      | 30.5    |
| 2884     | 44.5  | 4.0        | 1.4       | 73.7    | 19.3       | 30.8      | 31.7    |
| 4671     | 44.0  | 4.0        | 1.2       | 73.7    | 19.5       | 29.9      | 34.7    |
| 2976     | 45.5  | 3.9        | 1.5       | 73.7    | 19.3       | 34.3      | 30.4    |
| 4461     | 39.2  | 4.0        | 1.4       | 73.7    | 19.4       | 26.8      | 39.2    |
| 1449     | 36.3  | 4.3        | 1.3       | 73.6    | 19.1       | 21.3      | 41.3    |
| 3013     | 45.6  | 4.4        | 1.8       | 73.6    | 18.7       | 33.4      | 34.5    |
| 1448     | 38.6  | 4.5        | 1.4       | 73.6    | 19.1       | 23.4      | 41.2    |
| 4788     | 49.9  | 4.1        | 1.7       | 73.6    | 19.0       | 39.5      | 23.2    |
| 4453     | 45.4  | 3.7        | 1.5       | 73.6    | 19.7       | 29.1      | 36.6    |
| 2886     | 43.7  | 4.1        | 1.3       | 73.5    | 19.5       | 29.0      | 32.7    |
| 4152     | 45.0  | 4.3        | 1.3       | 73.5    | 19.2       | 36.0      | 31.0    |
| 3012     | 43.8  | 4.3        | 1.8       | 73.5    | 18.4       |           |         |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 2030     | 37.9  | 3.8        | 1.6       | 73.5    | 19.3       | 26.5      | 34.0    |
| 453      | 41.3  | 4.1        | 1.4       | 73.5    | 19.3       | 29.3      | 33.6    |
| 3988     | 45.4  | 4.2        | 1.6       | 73.5    | 18.9       | 36.7      | 25.9    |
| 331      | 40.5  | 4.2        | 1.2       | 73.5    | 19.3       | 23.8      | 40.3    |
| 869      | 42.8  | 3.8        | 1.3       | 73.5    | 19.8       | 42.7      | 18.8    |
| 757      | 39.0  | 4.1        | 1.3       | 73.5    | 19.7       | 19.0      | 41.7    |
| 2433     | 40.2  | 4.4        | 1.4       | 73.5    | 19.0       | 24.2      | 39.8    |
| 4614     | 45.8  | 4.0        | 1.7       | 73.5    | 19.2       | 33.3      | 31.0    |
| 3045     | 43.4  | 4.2        | 1.4       | 73.5    | 19.4       | 23.9      | 36.8    |
| 1443     | 36.8  | 4.4        | 1.3       | 73.4    | 19.2       | 23.9      | 41.4    |
| 2437     | 39.5  | 4.4        | 1.3       | 73.4    | 19.2       | 20.3      | 37.0    |
| 2043     | 36.8  | 3.8        | 1.7       | 73.4    | 19.3       | 28.4      | 36.5    |
| 4556     | 41.2  | 4.1        | 1.2       | 73.3    | 19.9       | 25.8      | 35.5    |
| 3331     | 41.0  | 3.9        | 1.3       | 73.3    | 20.0       | 26.0      | 34.7    |
| 645      | 38.8  | 3.9        | 1.2       | 73.3    | 20.2       | 29.2      | 36.8    |
| 2296     | 40.0  | 3.8        | 1.3       | 73.3    | 20.0       | 30.1      | 33.9    |
| 2295     | 40.4  | 3.9        | 1.3       | 73.3    | 20.1       | 28.1      | 33.5    |
| 2990     | 40.9  | 3.9        | 2.0       | 73.3    | 19.2       | 28.1      | 38.0    |
| 2953     | 39.0  | 4.5        | 1.5       | 73.3    | 19.1       | 25.5      | 37.4    |
| 4150     | 44.2  | 4.3        | 1.2       | 73.3    | 19.7       | 36.4      | 27.3    |
| 2908     | 38.3  | 4.5        | 1.4       | 73.2    | 19.3       | 24.2      | 39.7    |
| 2287     | 40.9  | 3.9        | 1.3       | 73.2    | 20.1       | 31.6      | 33.6    |
| 4151     | 46.1  | 4.3        | 1.3       | 73.2    | 19.6       | 35.3      | 27.9    |
| 2438     | 40.5  | 4.5        | 1.6       | 73.2    | 18.9       | 25.1      | 35.9    |
| 1333     | 48.5  | 4.2        | 1.3       | 73.2    | 19.5       | 37.1      | 29.9    |
| 2946     | 39.2  | 4.6        | 1.4       | 73.2    | 19.2       | 27.0      | 36.1    |
| 4615     | 44.8  | 4.2        | 1.7       | 73.1    | 19.5       | 31.7      | 31.4    |
| 2888     | 40.0  | 4.0        | 1.2       | 73.1    | 20.1       | 25.3      | 36.6    |
| 4002     | 43.5  | 3.7        | 1.7       | 73.0    | 19.8       | 34.0      | 31.8    |
| 2892     | 41.4  | 4.1        | 1.2       | 73.0    | 20.0       | 30.1      | 35.5    |
| 1767     | 36.6  | 3.9        | 1.2       | 73.0    | 20.4       | 26.3      | 38.5    |
| 2948     | 39.3  | 4.5        | 1.4       | 72.9    | 19.6       | 22.1      | 39.6    |
| 2291     | 40.8  | 3.8        | 1.3       | 72.9    | 20.2       | 30.0      | 34.8    |
| 1268     | 39.5  | 4.5        | 1.2       | 72.9    | 19.6       | 21.6      | 41.3    |
| 2975     | 40.4  | 3.9        | 1.5       | 72.9    | 20.0       | 29.6      | 34.2    |
| 1431     | 38.1  | 4.5        | 1.2       | 72.9    | 19.9       | 21.1      | 41.6    |
| 2293     | 37.9  | 3.9        | 1.2       | 72.9    | 20.5       | 31.3      | 32.7    |
| 4632     | 34.4  | 4.4        | 1.3       | 72.9    | 20.0       | 24.3      | 40.0    |
| 1734     | 45.1  | 4.4        | 1.4       | 72.9    | 19.6       | 34.2      | 27.4    |
| 4538     | 43.5  | 4.0        | 1.5       | 72.9    | 20.0       | 28.1      | 36.4    |
| 1270     | 36.6  | 4.4        | 1.4       | 72.9    | 19.6       | 20.6      | 42.9    |
| 343      | 35.8  | 4.1        | 1.9       | 72.9    | 19.0       | 32.0      | 26.9    |
| 3053     | 43.9  | 4.1        | 1.5       | 72.8    | 20.0       | 28.9      | 33.1    |
| 2434     | 40.0  | 4.4        | 1.4       | 72.8    | 19.6       | 25.3      | 36.9    |
| 4789     | 50.2  | 4.1        | 1.7       | 72.8    | 19.6       | 39.0      | 21.2    |
| 4446     | 37.9  | 3.9        | 1.2       | 72.8    | 20.4       | 30.7      | 32.5    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 1773     | 41.1  | 4.1        | 1.2       | 72.8    | 20.4       | 31.1      | 30.3    |
| 738      | 38.1  | 4.2        | 1.5       | 72.8    | 19.7       | 21.8      | 43.0    |
| 4483     | 42.2  | 4.2        | 1.7       | 72.7    | 20.0       | 28.7      | 35.2    |
| 2402     | 42.3  | 4.0        | 1.4       | 72.7    | 20.0       | 39.1      | 23.0    |
| 1438     | 34.3  | 4.3        | 1.2       | 72.7    | 20.0       | 23.1      | 39.4    |
| 4616     | 44.7  | 4.2        | 1.8       | 72.7    | 19.8       | 36.4      | 27.2    |
| 1632     | 47.6  | 4.7        | 1.4       | 72.7    | 19.6       | 27.9      | 31.1    |
| 2882     | 38.5  | 4.2        | 1.3       | 72.7    | 21.3       | 26.6      | 36.6    |
| 1276     | 40.1  | 4.3        | 1.5       | 72.7    | 20.0       | 26.3      | 37.3    |
| 4006     | 40.4  | 4.1        | 1.9       | 72.7    | 19.7       | 29.0      | 33.6    |
| 2430     | 41.1  | 4.4        | 1.5       | 72.6    | 19.7       | 21.5      | 41.7    |
| 1013     | 40.5  | 3.9        | 1.5       | 72.6    | 20.2       | 27.4      | 36.2    |
| 2952     | 37.9  | 4.5        | 1.8       | 72.6    | 19.4       | 22.8      | 38.7    |
| 2989     | 41.1  | 4.1        | 1.8       | 72.5    | 19.8       | 31.5      | 34.1    |
| 216      | 37.5  | 4.5        | 1.4       | 72.5    | 19.7       | 29.2      | 27.7    |
| 1604     | 48.6  | 3.8        | 1.4       | 72.5    | 20.7       | 36.8      | 22.2    |
| 2936     | 29.8  | 4.4        | 1.6       | 72.5    | 19.8       | 23.0      | 39.6    |
| 1444     | 37.3  | 4.4        | 1.2       | 72.5    | 20.1       | 22.3      | 39.3    |
| 1637     | 46.9  | 4.4        | 1.2       | 72.5    | 20.3       | 31.0      | 28.3    |
| 3750     | 44.5  | 4.0        | 1.8       | 72.5    | 20.1       | 34.0      | 32.8    |
| 210      | 40.3  | 4.1        | 1.3       | 72.5    | 20.4       | 40.8      | 18.0    |
| 3050     | 42.9  | 4.1        | 1.4       | 72.5    | 20.3       | 21.0      | 38.9    |
| 4153     | 46.3  | 4.3        | 1.3       | 72.5    | 20.4       | 38.4      | 26.9    |
| 3046     | 42.7  | 4.6        | 1.5       | 72.4    | 19.8       | 22.4      | 38.2    |
| 2305     | 37.0  | 3.9        | 1.3       | 72.4    | 20.8       | 31.4      | 32.8    |
| 4666     | 43.5  | 4.6        | 1.4       | 72.4    | 20.0       | 32.3      | 30.9    |
| 2945     | 41.3  | 4.1        | 1.4       | 72.4    | 20.5       | 23.4      | 38.2    |
| 2403     | 40.8  | 4.0        | 1.5       | 72.4    | 20.3       | 41.3      | 20.1    |
| 2891     | 41.7  | 4.1        | 1.2       | 72.4    | 20.7       | 27.7      | 34.7    |
| 3330     | 40.9  | 3.9        | 1.3       | 72.4    | 21.0       | 28.1      | 33.9    |
| 1625     | 46.3  | 4.6        | 1.4       | 72.3    | 20.2       | 26.6      | 33.4    |
| 2082     | 41.9  | 4.5        | 1.3       | 72.3    | 20.2       | 26.7      | 33.8    |
| 2297     | 41.1  | 3.8        | 1.3       | 72.3    | 20.9       | 29.1      | 33.6    |
| 4568     | 49.1  | 4.2        | 2.5       | 72.3    | 19.5       | 41.1      | 23.9    |
| 2306     | 38.9  | 3.8        | 1.3       | 72.3    | 21.0       | 30.3      | 34.0    |
| 2175     | 46.0  | 4.0        | 1.2       | 72.2    | 21.1       | 25.0      | 33.3    |
| 967      | 41.2  | 4.3        | 1.5       | 72.2    | 20.3       | 19.3      | 42.0    |
| 4722     | 41.2  | 3.7        | 1.5       | 72.2    | 21.0       | 26.3      | 36.0    |
| 4488     | 44.6  | 4.3        | 1.6       | 72.2    | 20.5       | 23.9      | 34.2    |
| 1628     | 45.4  | 4.3        | 1.4       | 72.2    | 20.5       | 29.6      | 30.4    |
| 4149     | 47.0  | 4.4        | 1.3       | 72.2    | 20.6       | 34.5      | 28.7    |
| 4843     | 44.1  | 4.2        | 1.4       | 72.1    | 20.8       | 37.1      | 25.2    |
| 1275     | 42.5  | 4.5        | 1.3       | 72.1    | 20.6       | 24.2      | 37.0    |
| 3196     | 37.6  | 4.2        | 1.6       | 72.1    | 20.6       | 25.0      | 37.0    |
| 2203     | 36.1  | 4.0        | 1.6       | 72.1    | 20.4       | 24.0      | 37.3    |
| 4101     | 44.3  | 4.0        | 1.4       | 72.1    | 21.0       | 33.0      | 30.3    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4546     | 40.9  | 3.8        | 1.3       | 72.1    | 21.1       | 29.9      | 37.6    |
| 214      | 43.0  | 4.6        | 1.4       | 72.1    | 20.0       | 30.3      | 26.8    |
| 2302     | 36.9  | 3.8        | 1.3       | 72.1    | 21.1       | 31.6      | 32.6    |
| 2303     | 37.0  | 3.9        | 1.3       | 72.1    | 21.2       | 28.4      | 34.4    |
| 4812     | 42.1  | 4.0        | 1.6       | 72.0    | 20.8       | 24.5      | 42.3    |
| 2912     | 40.2  | 4.0        | 1.4       | 72.0    | 21.0       | 27.2      | 38.2    |
| 4155     | 39.4  | 4.0        | 1.4       | 72.0    | 21.3       | 32.6      | 34.1    |
| 4486     | 35.9  | 4.2        | 1.6       | 71.9    | 20.8       | 26.3      | 40.0    |
| 2435     | 41.8  | 4.5        | 1.4       | 71.9    | 20.5       | 23.5      | 38.9    |
| 1395     | 42.4  | 4.5        | 1.6       | 71.9    | 20.3       | 26.8      | 37.6    |
| 2978     | 44.7  | 4.1        | 1.7       | 71.9    | 20.7       | 30.9      | 33.5    |
| 2851     | 35.3  | 4.0        | 2.3       | 71.9    | 20.1       | 28.7      | 37.6    |
| 641      | 38.2  | 4.1        | 1.2       | 71.9    | 21.3       | 23.2      | 38.5    |
| 4512     | 44.7  | 4.0        | 1.5       | 71.9    | 20.9       | 29.7      | 34.8    |
| 1442     | 42.0  | 4.2        | 1.1       | 71.9    | 21.1       | 28.3      | 35.3    |
| 4489     | 40.1  | 4.7        | 1.3       | 71.9    | 20.7       | 24.7      | 35.6    |
| 1306     | 39.9  | 4.4        | 1.4       | 71.9    | 20.7       | 28.3      | 39.4    |
| 4670     | 45.0  | 4.2        | 1.3       | 71.9    | 21.0       | 27.7      | 38.0    |
| 2905     | 44.6  | 4.0        | 1.4       | 71.8    | 21.1       | 29.6      | 32.7    |
| 2289     | 38.8  | 3.9        | 1.3       | 71.8    | 21.5       | 32.4      | 33.6    |
| 2294     | 39.3  | 3.9        | 1.3       | 71.8    | 21.5       | 29.4      | 32.2    |
| 2885     | 43.7  | 4.1        | 1.4       | 71.8    | 21.2       | 31.5      | 32.5    |
| 1441     | 38.9  | 4.4        | 1.4       | 71.8    | 20.8       | 26.5      | 37.7    |
| 4612     | 43.5  | 4.2        | 1.8       | 71.8    | 20.5       | 30.9      | 32.7    |
| 1457     | 43.1  | 4.4        | 1.5       | 71.7    | 20.7       | 27.5      | 32.0    |
| 4669     | 39.3  | 4.1        | 1.3       | 71.7    | 21.3       | 28.9      | 39.7    |
| 4613     | 42.9  | 4.2        | 1.6       | 71.7    | 20.8       | 29.0      | 34.9    |
| 188      | 38.8  | 4.0        | 1.9       | 71.7    | 20.9       | 26.0      | 36.3    |
| 4835     | 43.4  | 4.4        | 1.5       | 71.7    | 20.9       | 27.2      | 37.8    |
| 2997     | 37.3  | 4.2        | 1.5       | 71.7    | 21.1       | 27.2      | 38.0    |
| 4063     | 41.3  | 4.4        | 1.3       | 71.7    | 21.2       | 23.4      | 36.3    |
| 4102     | 36.3  | 3.9        | 1.3       | 71.6    | 21.5       | 26.4      | 38.7    |
| 3047     | 41.3  | 4.4        | 1.4       | 71.6    | 20.8       | 22.1      | 37.7    |
| 1271     | 38.9  | 4.6        | 1.6       | 71.6    | 20.6       | 21.9      | 40.1    |
| 1429     | 39.6  | 4.2        | 1.3       | 71.6    | 21.3       | 24.9      | 40.7    |
| 2041     | 37.0  | 3.9        | 1.7       | 71.5    | 21.1       | 27.1      | 35.7    |
| 2288     | 38.7  | 4.0        | 1.3       | 71.5    | 21.8       | 31.6      | 33.3    |
| 4484     | 44.0  | 4.2        | 1.9       | 71.5    | 20.9       | 28.0      | 33.3    |
| 2174     | 45.0  | 4.1        | 1.2       | 71.5    | 21.6       | 25.5      | 36.8    |
| 273      | 48.7  | 4.5        | 1.7       | 71.5    | 20.6       | 38.2      | 21.8    |
| 4001     | 42.5  | 3.9        | 1.7       | 71.5    | 21.3       | 33.6      | 30.2    |
| 1437     | 40.0  | 4.4        | 1.3       | 71.4    | 21.3       | 25.9      | 37.5    |
| 3933     | 47.4  | 3.7        | 1.5       | 71.4    | 21.8       | 38.2      | 26.0    |
| 4487     | 40.1  | 4.6        | 2.2       | 71.4    | 20.3       | 26.7      | 38.2    |
| 1447     | 39.3  | 4.3        | 1.4       | 71.4    | 21.2       | 25.5      | 40.8    |
| 4270     | 43.1  | 4.4        | 1.6       | 71.3    | 20.9       | 32.2      | 29.0    |

| SAMPLE<br># | %<br>OIL | %<br>PALMITIC | %<br>STEARIC | %<br>OLEIC | %<br>LINOLEIC | %<br>PROTEIN | %<br>FIBER |
|-------------|----------|---------------|--------------|------------|---------------|--------------|------------|
|             | NMR      | C-16:0        | C-18:0       | C-18:1     | C-18:2        | NIR          | NIR        |
| 1445        | 35.0     | 4.4           | 1.1          | 71.3       | 21.4          | 24.9         | 40.2       |
| 1278        | 40.8     | 4.4           | 1.4          | 71.3       | 21.2          | 20.9         | 39.4       |
| 4733        | 41.5     | 4.2           | 1.4          | 71.3       | 21.5          | 27.7         | 37.6       |
| 4672        | 42.8     | 4.4           | 1.4          | 71.3       | 21.2          | 27.7         | 36.0       |
| 1396        | 46.8     | 4.4           | 1.4          | 71.3       | 21.3          | 29.2         | 32.3       |
| 4018        | 39.3     | 4.0           | 1.7          | 71.2       | 21.5          | 27.6         | 37.0       |
| 4817        | 41.9     | 4.3           | 1.6          | 71.2       | 21.2          | 28.4         | 36.3       |
| 4378        | 39.7     | 4.2           | 1.4          | 71.2       | 21.7          | 32.5         | 33.4       |
| 2177        | 46.1     | 4.0           | 1.3          | 71.2       | 21.9          | 26.6         | 33.0       |
| 2991        | 38.2     | 4.2           | 1.6          | 71.2       | 21.4          | 26.3         | 40.2       |
| 1277        | 39.8     | 4.4           | 1.5          | 71.2       | 21.4          | 26.1         | 39.0       |
| 1096        | 43.3     | 4.4           | 1.4          | 71.2       | 21.4          | 26.9         | 33.6       |
| 1769        | 38.6     | 4.3           | 1.4          | 71.2       | 21.8          | 25.8         | 35.3       |
| 1266        | 40.8     | 4.7           | 1.3          | 71.1       | 21.2          | 20.3         | 40.1       |
| 2951        | 34.2     | 4.7           | 1.5          | 71.1       | 20.9          | 21.1         | 36.8       |
| 1451        | 38.6     | 4.5           | 1.3          | 71.1       | 21.5          | 21.1         | 40.3       |
| 4611        | 46.0     | 4.4           | 1.4          | 71.1       | 21.8          | 34.2         | 30.4       |
| 274         | 49.0     | 4.5           | 1.6          | 71.1       | 21.2          | 38.9         | 23.5       |
| 344         | 37.3     | 4.1           | 1.8          | 71.0       | 21.0          | 33.8         | 28.1       |
| 2027        | 36.2     | 3.9           | 1.6          | 71.0       | 22.0          | 27.5         | 33.1       |
| 466         | 47.5     | 4.6           | 1.5          | 71.0       | 21.5          | 37.7         | 24.2       |
| 4856        | 37.7     | 4.0           | 1.7          | 71.0       | 21.3          | 37.1         | 25.3       |
| 1336        | 46.4     | 4.4           | 1.7          | 70.9       | 21.1          | 41.7         | 24.1       |
| 2301        | 39.2     | 4.0           | 1.4          | 70.9       | 22.1          | 30.1         | 32.9       |
| 215         | 40.6     | 4.9           | 1.4          | 70.9       | 21.0          | 29.4         | 26.3       |
| 1627        | 40.3     | 4.7           | 1.5          | 70.9       | 21.3          | 25.7         | 38.7       |



# HIGH OIL LINES



| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4542     | 50.9  | 6.4        | 1.8       | 8.1     | 81.8       | 37.7      | 23.0    |
| 3932     | 50.4  | 3.7        | 1.2       | 79.0    | 15.0       | 38.4      | 23.2    |
| 3930     | 50.2  | 3.9        | 1.3       | 76.4    | 16.9       | 40.8      | 18.9    |
| 4789     | 50.2  | 4.1        | 1.7       | 72.8    | 19.6       | 39.0      | 21.2    |
| 1118     | 49.9  | 4.7        | 1.7       | 39.2    | 53.0       | 34.5      | 21.8    |
| 4788     | 49.9  | 4.1        | 1.7       | 73.6    | 19.0       | 39.5      | 23.2    |
| 4748     | 49.8  | 4.9        | 1.9       | 9.2     | 82.2       | 32.9      | 31.8    |
| 4724     | 49.8  | 5.6        | 2.1       | 8.8     | 81.6       | 37.4      | 23.8    |
| 3918     | 49.8  | 5.3        | 2.3       | 8.1     | 82.4       | 34.0      | 24.7    |
| 4525     | 49.5  | 6.0        | 1.7       | 7.9     | 82.5       | 36.3      | 25.2    |
| 4747     | 49.4  | 5.6        | 2.1       | 8.3     | 82.0       | 33.5      | 30.1    |
| 3291     | 49.3  | 5.9        | 1.7       | 9.1     | 81.4       | 39.1      | 20.3    |
| 4622     | 49.2  | 5.8        | 2.0       | 26.1    | 64.6       | 39.5      | 21.6    |
| 275      | 49.2  | 4.4        | 1.6       | 70.4    | 22.0       | 37.4      | 23.5    |
| 4568     | 49.1  | 4.2        | 2.5       | 72.3    | 19.5       | 41.1      | 23.9    |
| 274      | 49.0  | 4.5        | 1.6       | 71.1    | 21.2       | 38.9      | 23.5    |
| 3544     | 48.9  | 5.1        | 1.9       | 8.5     | 82.5       | 37.9      | 25.7    |
| 809      | 48.9  | 5.0        | 2.2       | 8.4     | 83.0       | 38.1      | 24.9    |
| 1327     | 48.8  | 4.2        | 1.3       | 74.2    | 18.6       | 36.8      | 27.1    |
| 3543     | 48.8  | 5.1        | 1.8       | 7.9     | 83.2       | 37.5      | 24.0    |
| 3931     | 48.8  | 4.2        | 1.4       | 75.5    | 17.4       | 41.7      | 20.2    |
| 444      | 48.8  | 5.0        | 2.2       | 7.6     | 83.5       | 38.3      | 21.9    |
| 4728     | 48.8  | 5.1        | 1.6       | 8.4     | 82.8       | 37.2      | 24.7    |
| 1646     | 48.7  | 4.7        | 1.3       | 66.7    | 25.9       | 37.7      | 18.4    |
| 273      | 48.7  | 4.5        | 1.7       | 71.5    | 20.6       | 38.2      | 21.8    |
| 1393     | 48.6  | 4.6        | 1.4       | 66.3    | 26.1       | 30.0      | 32.4    |
| 1604     | 48.6  | 3.8        | 1.4       | 72.5    | 20.7       | 36.8      | 22.2    |
| 4761     | 48.6  | 5.7        | 1.6       | 9.4     | 81.4       | 39.5      | 18.2    |
| 1333     | 48.5  | 4.2        | 1.3       | 73.2    | 19.5       | 37.1      | 29.9    |
| 4725     | 48.5  | 5.7        | 1.6       | 8.9     | 81.8       | 37.7      | 24.4    |
| 1691     | 48.5  | 5.6        | 1.7       | 8.1     | 83.0       | 37.4      | 19.7    |
| 446      | 48.5  | 5.1        | 2.4       | 8.0     | 82.9       | 39.2      | 21.4    |
| 4570     | 48.4  | 6.1        | 3.0       | 8.6     | 80.4       | 39.8      | 21.5    |
| 4852     | 48.4  | 4.4        | 1.4       | 68.9    | 23.5       | 32.8      | 30.1    |
| 3071     | 48.4  | 5.1        | 2.1       | 9.2     | 81.7       | 34.3      | 27.0    |
| 4726     | 48.3  | 5.7        | 1.8       | 8.5     | 82.0       | 39.5      | 23.2    |
| 2984     | 48.3  | 4.3        | 1.5       | 74.6    | 18.0       | 35.4      | 28.1    |
| 4148     | 48.2  | 4.4        | 1.3       | 74.1    | 18.5       | 37.3      | 25.5    |
| 448      | 48.2  | 5.0        | 2.3       | 8.3     | 82.8       | 41.1      | 21.1    |
| 3292     | 48.1  | 5.9        | 1.7       | 9.3     | 81.2       | 38.1      | 21.4    |
| 445      | 48.1  | 5.0        | 2.2       | 8.1     | 83.1       |           |         |
| 585      | 48.1  | 5.1        | 1.8       | 9.6     | 82.2       | 43.6      | 20.9    |
| 3542     | 48.0  | 5.1        | 1.9       | 8.5     | 82.5       | 33.0      | 34.2    |
| 3283     | 48.0  | 5.6        | 2.1       | 9.9     | 80.5       | 37.4      | 24.0    |
| 3010     | 47.9  | 3.9        | 1.7       | 76.2    | 16.6       | 35.0      | 33.7    |
| 4253     | 47.9  | 6.5        | 1.6       | 7.4     | 82.5       | 38.3      | 19.3    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4762     | 47.9  | 5.3        | 1.9       | 8.1     | 82.8       | 33.6      | 27.3    |
| 435      | 47.9  | 5.1        | 2.5       | 8.2     | 82.4       | 36.1      | 27.9    |
| 3916     | 47.9  | 4.9        | 2.0       | 8.7     | 82.7       | 26.0      | 36.1    |
| 1631     | 47.8  | 5.2        | 1.9       | 7.9     | 82.4       | 39.6      | 17.6    |
| 4875     | 47.8  | 3.5        | 1.4       | 78.3    | 15.3       | 34.8      | 27.9    |
| 4501     | 47.8  | 5.0        | 1.6       | 9.9     | 81.6       | 38.2      | 22.9    |
| 1401     | 47.8  | 4.7        | 1.4       | 65.7    | 26.5       | 31.3      | 25.6    |
| 3178     | 47.8  | 5.5        | 1.8       | 9.4     | 81.1       | 42.0      | 20.8    |
| 3181     | 47.7  | 5.7        | 2.0       | 9.6     | 80.8       | 37.1      | 25.5    |
| 677      | 47.7  | 5.3        | 1.8       | 9.6     | 82.0       | 39.2      | 23.1    |
| 3917     | 47.7  | 4.9        | 2.0       | 8.7     | 82.7       | 26.1      | 34.2    |
| 1116     | 47.7  | 5.2        | 1.8       | 21.0    | 70.7       | 28.9      | 32.3    |
| 4809     | 47.7  | 5.3        | 1.5       | 8.9     | 82.4       | 36.0      | 23.4    |
| 4697     | 47.7  | 5.2        | 2.0       | 9.4     | 81.4       | 35.3      | 27.8    |
| 449      | 47.7  | 5.0        | 2.3       | 8.3     | 82.9       | 39.0      | 23.9    |
| 4334     | 47.7  | 4.9        | 1.8       | 8.0     | 83.5       | 40.1      | 23.9    |
| 1337     | 47.6  | 5.7        | 1.5       | 20.8    | 69.9       | 37.3      | 27.9    |
| 1632     | 47.6  | 4.7        | 1.4       | 72.7    | 19.6       | 27.9      | 31.1    |
| 4571     | 47.6  | 5.6        | 2.4       | 9.7     | 80.4       | 38.3      | 23.7    |
| 3290     | 47.6  | 5.8        | 1.6       | 10.3    | 80.4       | 30.5      | 25.5    |
| 4589     | 47.6  | 5.4        | 1.8       | 9.1     | 81.9       | 36.1      | 22.7    |
| 1672     | 47.6  | 5.3        | 2.0       | 8.9     | 81.9       | 41.8      | 17.2    |
| 2845     | 47.6  | 5.9        | 1.8       | 9.3     | 81.2       | 38.5      | 22.1    |
| 466      | 47.5  | 4.6        | 1.5       | 71.0    | 21.5       | 37.7      | 24.2    |
| 3933     | 47.4  | 3.7        | 1.5       | 71.4    | 21.8       | 38.2      | 26.0    |
| 4343     | 47.4  | 5.9        | 2.0       | 9.4     | 80.8       | 36.7      | 23.1    |
| 562      | 47.4  | 4.8        | 1.8       | 32.2    | 59.7       | 35.7      | 23.6    |
| 647      | 47.4  | 4.0        | 1.3       | 74.0    | 19.3       | 37.7      | 22.7    |
| 1328     | 47.3  | 5.0        | 1.5       | 35.7    | 53.1       | 33.1      | 32.5    |
| 1602     | 47.3  | 5.1        | 1.6       | 33.4    | 58.6       | 36.0      | 20.7    |
| 1592     | 47.3  | 6.0        | 1.9       | 9.1     | 81.5       | 37.5      | 26.2    |
| 1365     | 47.3  | 4.5        | 1.3       | 67.1    | 25.4       | 37.4      | 23.8    |
| 276      | 47.3  | 4.3        | 1.6       | 68.1    | 24.2       | 36.4      | 23.3    |
| 1391     | 47.3  | 5.3        | 1.7       | 30.6    | 60.9       | 36.4      | 25.7    |
| 4732     | 47.3  | 5.5        | 1.9       | 9.7     | 80.9       | 38.9      | 23.9    |
| 4853     | 47.3  | 4.6        | 1.5       | 70.8    | 21.3       | 33.9      | 27.7    |
| 576      | 47.3  | 4.9        | 1.6       | 9.6     | 82.2       | 43.9      | 18.1    |
| 4623     | 47.2  | 6.4        | 1.9       | 13.3    | 76.3       | 34.4      | 24.8    |
| 3541     | 47.2  | 5.1        | 1.8       | 8.5     | 82.5       | 37.3      | 31.6    |
| 2117     | 47.2  | 4.4        | 1.8       | 69.4    | 22.7       | 36.7      | 22.0    |
| 1367     | 47.2  | 5.7        | 1.8       | 8.8     | 82.2       | 39.1      | 20.7    |
| 4066     | 47.2  | 5.0        | 1.7       | 45.4    | 46.2       | 31.3      | 27.9    |
| 442      | 47.2  | 5.2        | 2.4       | 7.2     | 83.6       | 39.4      | 19.4    |
| 4645     | 47.2  | 5.5        | 2.0       | 9.4     | 81.1       | 37.1      | 26.0    |
| 1309     | 47.1  | 5.8        | 1.9       | 10.2    | 80.7       | 31.1      | 30.9    |
| 637      | 47.1  | 5.2        | 2.0       | 9.2     | 82.2       | 33.6      | 27.1    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 783      | 47.1  | 5.7        | 1.8       | 8.9     | 82.1       | 35.8      | 23.7    |
| 4149     | 47.0  | 4.4        | 1.3       | 72.2    | 20.6       | 34.5      | 28.7    |
| 212      | 47.0  | 3.6        | 1.3       | 80.8    | 12.4       | 38.9      | 19.1    |
| 2518     | 47.0  | 5.5        | 1.9       | 8.3     | 82.3       | 36.4      | 22.6    |
| 4456     | 47.0  | 4.8        | 1.7       | 9.2     | 82.5       | 36.0      | 29.4    |
| 2985     | 47.0  | 4.1        | 1.4       | 76.9    | 15.9       | 40.0      | 23.1    |
| 1643     | 47.0  | 5.9        | 1.5       | 10.2    | 80.0       |           |         |
| 1111     | 47.0  | 5.5        | 1.9       | 9.1     | 82.1       | 35.6      | 26.3    |
| 4524     | 47.0  | 6.0        | 1.8       | 9.6     | 80.7       | 37.3      | 24.5    |
| 3310     | 47.0  | 5.6        | 1.7       | 9.8     | 80.9       | 38.3      | 25.2    |
| 1114     | 46.9  | 5.3        | 1.9       | 9.6     | 81.8       | 27.0      | 30.5    |
| 4657     | 46.9  | 5.5        | 1.8       | 8.4     | 82.3       | 31.9      | 30.7    |
| 2771     | 46.9  | 5.3        | 2.2       | 7.2     | 83.3       | 29.1      | 32.9    |
| 4521     | 46.9  | 5.1        | 2.2       | 8.2     | 82.6       | 38.2      | 22.1    |
| 4258     | 46.9  | 5.6        | 1.7       | 8.4     | 82.4       | 40.3      | 31.1    |
| 577      | 46.9  | 5.3        | 1.8       | 9.5     | 81.8       | 42.4      | 18.6    |
| 1833     | 46.9  | 5.5        | 1.9       | 9.8     | 81.5       | 42.3      | 20.9    |
| 1637     | 46.9  | 4.4        | 1.2       | 72.5    | 20.3       | 31.0      | 28.3    |
| 3561     | 46.9  | 5.9        | 1.7       | 8.4     | 82.0       | 26.3      | 34.5    |
| 1396     | 46.8  | 4.4        | 1.4       | 71.3    | 21.3       | 29.2      | 32.3    |
| 3538     | 46.8  | 5.2        | 1.9       | 7.6     | 83.3       | 35.2      | 28.9    |
| 4252     | 46.7  | 6.3        | 1.5       | 7.3     | 82.8       | 39.7      | 18.4    |
| 4355     | 46.7  | 4.3        | 1.4       | 73.7    | 19.1       | 28.9      | 32.0    |
| 4794     | 46.7  | 5.3        | 1.7       | 7.2     | 84.1       | 32.6      | 31.0    |
| 634      | 46.7  | 5.1        | 2.0       | 8.6     | 82.9       | 39.1      | 22.2    |
| 4651     | 46.7  | 6.2        | 2.1       | 9.3     | 80.3       | 35.5      | 26.9    |
| 2123     | 46.7  | 5.5        | 1.8       | 7.7     | 83.6       | 36.3      | 25.3    |
| 4730     | 46.6  | 5.6        | 1.8       | 9.0     | 81.5       | 37.8      | 25.0    |
| 4646     | 46.6  | 5.7        | 2.9       | 9.5     | 80.0       | 38.8      | 23.4    |
| 1192     | 46.6  | 5.7        | 1.7       | 8.3     | 82.8       | 37.0      | 22.1    |
| 3915     | 46.6  | 4.9        | 1.9       | 8.6     | 82.8       | 30.7      | 32.5    |
| 3914     | 46.6  | 4.8        | 1.9       | 8.7     | 82.7       | 34.3      | 33.5    |
| 3686     | 46.6  | 5.6        | 2.1       | 8.3     | 82.0       | 32.5      | 31.7    |
| 2172     | 46.6  | 4.2        | 1.3       | 67.2    | 25.9       | 28.1      | 32.5    |
| 434      | 46.5  | 5.0        | 2.4       | 8.3     | 82.7       | 37.2      | 25.8    |
| 4010     | 46.5  | 5.1        | 2.2       | 8.0     | 82.8       | 40.7      | 18.7    |
| 2246     | 46.5  | 3.9        | 1.4       | 77.4    | 15.6       | 34.3      | 26.6    |
| 1332     | 46.5  | 3.9        | 1.4       | 78.2    | 14.7       | 36.9      | 27.6    |
| 4522     | 46.5  | 5.1        | 1.9       | 9.3     | 81.9       | 35.1      | 29.7    |
| 4695     | 46.5  | 5.3        | 1.6       | 7.4     | 83.8       | 37.1      | 22.4    |
| 1191     | 46.4  | 5.9        | 1.7       | 7.7     | 82.8       | 34.3      | 23.9    |
| 4743     | 46.4  | 5.3        | 1.7       | 9.1     | 82.0       | 36.2      | 28.8    |
| 785      | 46.4  | 5.4        | 2.1       | 9.9     | 80.9       | 39.9      | 23.3    |
| 4727     | 46.4  | 5.7        | 1.6       | 7.9     | 82.9       | 35.8      | 24.4    |
| 1336     | 46.4  | 4.4        | 1.7       | 70.9    | 21.1       | 41.7      | 24.1    |
| 3350     | 46.4  | 5.5        | 2.0       | 9.9     | 80.4       |           |         |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 447      | 46.4  | 5.0        | 2.3       | 8.6     | 82.5       | 39.4      | 25.2    |
| 4624     | 46.4  | 6.0        | 2.1       | 9.7     | 80.4       | 36.9      | 27.0    |
| 4153     | 46.3  | 4.3        | 1.3       | 72.5    | 20.4       | 38.4      | 26.9    |
| 4867     | 46.3  | 5.2        | 1.8       | 10.8    | 80.6       | 40.1      | 24.2    |
| 3537     | 46.3  | 5.1        | 1.8       | 7.4     | 83.6       | 38.2      | 26.9    |
| 4504     | 46.3  | 5.1        | 1.8       | 8.7     | 82.5       | 34.3      | 29.4    |
| 238      | 46.3  | 6.2        | 1.7       | 8.6     | 81.6       | 40.1      | 21.3    |
| 506      | 46.3  | 5.5        | 1.7       | 9.8     | 81.1       |           |         |
| 4330     | 46.3  | 4.4        | 1.5       | 37.5    | 55.4       | 40.7      | 26.9    |
| 1625     | 46.3  | 4.6        | 1.4       | 72.3    | 20.2       | 26.6      | 33.4    |
| 3014     | 46.2  | 4.1        | 1.7       | 75.9    | 16.8       | 35.6      | 28.8    |
| 2857     | 46.2  | 6.1        | 1.5       | 7.8     | 82.5       | 32.8      | 27.9    |
| 2125     | 46.2  | 5.4        | 1.9       | 7.9     | 83.3       | 37.4      | 25.0    |
| 4557     | 46.2  | 6.0        | 2.2       | 10.1    | 79.7       | 37.1      | 23.5    |
| 3309     | 46.2  | 5.9        | 1.6       | 10.2    | 80.4       | 36.4      | 22.3    |
| 2173     | 46.2  | 4.1        | 1.2       | 69.9    | 23.2       | 27.8      | 33.7    |
| 4262     | 46.1  | 4.8        | 1.8       | 9.0     | 82.5       | 37.1      | 27.8    |
| 4151     | 46.1  | 4.3        | 1.3       | 73.2    | 19.6       | 35.3      | 27.9    |
| 2768     | 46.1  | 5.2        | 2.1       | 7.4     | 83.2       | 30.6      | 33.3    |
| 471      | 46.1  | 4.1        | 1.5       | 74.7    | 18.2       | 40.1      | 22.5    |
| 2158     | 46.1  | 5.3        | 1.8       | 10.0    | 81.3       | 41.6      | 18.5    |
| 211      | 46.1  | 3.5        | 1.2       | 79.5    | 13.9       | 40.1      | 18.6    |
| 4744     | 46.1  | 5.5        | 2.0       | 10.5    | 79.9       | 32.6      | 32.1    |
| 2177     | 46.1  | 4.0        | 1.3       | 71.2    | 21.9       | 26.6      | 33.0    |
| 3026     | 46.1  | 5.1        | 1.6       | 8.4     | 83.1       | 35.5      | 27.5    |
| 789      | 46.1  | 5.8        | 1.6       | 9.6     | 81.6       | 36.1      | 29.1    |
| 2175     | 46.0  | 4.0        | 1.2       | 72.2    | 21.1       | 25.0      | 33.3    |
| 4731     | 46.0  | 5.3        | 1.6       | 9.1     | 82.0       | 38.9      | 24.3    |
| 3562     | 46.0  | 5.8        | 1.6       | 8.5     | 81.6       | 30.5      | 34.0    |
| 4742     | 46.0  | 5.9        | 1.7       | 8.8     | 81.7       | 35.1      | 27.3    |
| 3403     | 46.0  | 5.1        | 2.1       | 8.5     | 82.4       | 40.1      | 22.9    |
| 3536     | 46.0  | 5.0        | 1.9       | 8.0     | 82.9       | 39.8      | 27.7    |
| 1636     | 46.0  | 5.4        | 1.4       | 32.3    | 59.5       | 34.8      | 20.1    |
| 4554     | 46.0  | 5.3        | 1.7       | 9.2     | 82.0       | 36.1      | 30.5    |
| 4072     | 46.0  | 5.3        | 2.1       | 7.8     | 82.8       | 38.1      | 24.4    |
| 4611     | 46.0  | 4.4        | 1.4       | 71.1    | 21.8       | 34.2      | 30.4    |
| 2769     | 46.0  | 5.2        | 2.1       | 7.2     | 83.5       | 30.1      | 32.1    |
| 4844     | 45.9  | 4.6        | 1.3       | 67.3    | 25.3       | 33.8      | 25.2    |
| 4776     | 45.9  | 6.0        | 1.8       | 8.6     | 81.7       | 35.3      | 31.4    |
| 438      | 45.9  | 5.2        | 2.4       | 8.3     | 82.5       | 37.4      | 27.6    |
| 550      | 45.9  | 5.0        | 1.8       | 10.3    | 81.6       | 41.1      | 22.9    |
| 3563     | 45.9  | 5.8        | 1.6       | 8.7     | 81.6       | 28.7      | 34.1    |
| 3352     | 45.9  | 5.6        | 2.2       | 8.9     | 81.4       | 31.9      | 32.9    |
| 4581     | 45.9  | 4.5        | 1.5       | 65.2    | 27.1       | 35.0      | 28.0    |
| 3857     | 45.9  | 5.3        | 2.2       | 7.8     | 82.9       | 36.0      | 27.3    |
| 3358     | 45.9  | 5.3        | 2.1       | 8.2     | 82.5       | 32.4      | 31.0    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 2772     | 45.9  | 5.2        | 2.1       | 7.2     | 83.4       | 28.8      | 33.7    |
| 1311     | 45.9  | 4.3        | 1.4       | 64.4    | 28.3       |           |         |
| 3072     | 45.9  | 5.0        | 2.0       | 9.4     | 81.7       | 37.8      | 26.4    |
| 3011     | 45.9  | 4.0        | 1.7       | 75.2    | 17.5       | 30.3      | 34.5    |
| 4402     | 45.9  | 5.9        | 1.7       | 8.9     | 81.4       | 38.1      | 24.1    |
| 1649     | 45.8  | 5.6        | 1.5       | 23.8    | 67.6       | 35.7      | 24.1    |
| 4650     | 45.8  | 5.3        | 2.7       | 8.7     | 81.3       | 30.4      | 37.5    |
| 4614     | 45.8  | 4.0        | 1.7       | 73.5    | 19.2       | 33.3      | 31.0    |
| 2207     | 45.8  | 4.9        | 1.9       | 9.6     | 82.2       | 41.1      | 24.3    |
| 544      | 45.8  | 4.9        | 2.1       | 9.8     | 81.9       | 40.4      | 21.4    |
| 3277     | 45.8  | 5.8        | 1.7       | 9.7     | 80.7       | 37.3      | 23.5    |
| 611      | 45.8  | 5.3        | 1.6       | 10.4    | 81.4       | 32.9      | 29.1    |
| 3870     | 45.8  | 5.6        | 1.9       | 8.6     | 82.0       | 30.6      | 34.9    |
| 1331     | 45.8  | 4.9        | 1.5       | 30.2    | 61.6       | 37.3      | 28.1    |
| 3427     | 45.8  | 4.0        | 1.3       | 69.5    | 23.5       | 34.8      | 29.1    |
| 427      | 45.8  | 5.5        | 1.7       | 8.6     | 82.1       |           |         |
| 1037     | 45.7  | 5.6        | 1.5       | 68.5    | 23.7       | 27.9      | 35.6    |
| 4784     | 45.7  | 5.7        | 1.7       | 8.5     | 82.2       | 38.2      | 24.4    |
| 3458     | 45.7  | 5.8        | 1.7       | 8.3     | 82.2       | 39.1      | 21.8    |
| 4009     | 45.7  | 5.0        | 2.2       | 8.1     | 82.9       | 42.4      | 16.1    |
| 2208     | 45.7  | 4.9        | 1.9       | 9.8     | 81.9       | 42.4      | 21.9    |
| 4437     | 45.7  | 4.9        | 1.9       | 9.0     | 82.4       | 38.8      | 22.5    |
| 4803     | 45.7  | 5.3        | 2.0       | 8.3     | 82.5       | 36.2      | 24.4    |
| 787      | 45.6  | 6.0        | 1.8       | 8.9     | 81.4       | 36.7      | 26.8    |
| 4715     | 45.6  | 5.6        | 1.9       | 9.1     | 81.5       | 35.1      | 24.7    |
| 3013     | 45.6  | 4.4        | 1.8       | 73.6    | 18.7       | 33.4      | 34.5    |
| 4596     | 45.6  | 4.9        | 1.9       | 8.6     | 82.8       | 38.3      | 25.4    |
| 514      | 45.6  | 5.5        | 1.7       | 9.1     | 82.0       | 40.0      | 20.8    |
| 2858     | 45.6  | 6.0        | 1.5       | 7.5     | 82.8       | 32.2      | 29.9    |
| 3461     | 45.6  | 6.0        | 1.7       | 8.2     | 82.1       | 38.2      | 22.9    |
| 4502     | 45.5  | 5.1        | 1.6       | 9.6     | 81.9       | 36.3      | 25.3    |
| 3697     | 45.5  | 5.8        | 1.8       | 37.4    | 53.6       | 27.8      | 32.7    |
| 2176     | 45.5  | 4.1        | 1.3       | 67.9    | 25.0       | 25.8      | 35.8    |
| 4673     | 45.5  | 4.3        | 1.4       | 69.5    | 23.2       | 28.6      | 35.1    |
| 2976     | 45.5  | 3.9        | 1.5       | 73.7    | 19.3       | 34.3      | 30.4    |
| 2906     | 45.5  | 4.0        | 1.5       | 70.3    | 22.6       | 28.6      | 35.2    |
| 1408     | 45.5  | 4.8        | 1.8       | 42.8    | 49.0       | 39.6      | 19.3    |
| 4841     | 45.5  | 4.2        | 1.3       | 68.7    | 24.2       | 23.4      | 39.3    |
| 2247     | 45.5  | 3.9        | 1.3       | 76.3    | 16.8       | 33.6      | 28.1    |
| 488      | 45.4  | 4.9        | 2.2       | 10.6    | 80.4       | 38.5      | 22.0    |
| 878      | 45.4  | 5.8        | 1.7       | 8.4     | 82.6       | 39.2      | 25.7    |
| 3749     | 45.4  | 5.6        | 2.1       | 8.5     | 81.8       | 35.3      | 24.5    |
| 3988     | 45.4  | 4.2        | 1.6       | 73.5    | 18.9       | 36.7      | 25.9    |
| 4649     | 45.4  | 5.4        | 2.8       | 10.1    | 79.7       | 38.3      | 27.5    |
| 3227     | 45.4  | 6.0        | 2.0       | 7.6     | 82.4       | 40.1      | 23.6    |
| 4342     | 45.4  | 6.1        | 2.0       | 9.0     | 81.0       | 37.3      | 23.5    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 868      | 45.4  | 5.3        | 1.4       | 19.5    | 71.4       |           |         |
| 1389     | 45.4  | 4.7        | 1.5       | 55.8    | 36.4       | 29.1      | 33.7    |
| 1628     | 45.4  | 4.3        | 1.4       | 72.2    | 20.5       | 29.6      | 30.4    |
| 4453     | 45.4  | 3.7        | 1.5       | 73.6    | 19.7       | 29.1      | 36.6    |
| 542      | 45.4  | 5.2        | 2.1       | 9.4     | 81.4       |           |         |
| 4592     | 45.4  | 5.9        | 1.6       | 8.5     | 82.1       | 36.7      | 29.4    |
| 1615     | 45.4  | 5.6        | 1.5       | 21.5    | 70.0       | 37.6      | 20.7    |
| 2852     | 45.3  | 5.1        | 1.8       | 10.3    | 80.9       | 42.5      | 21.3    |
| 3795     | 45.3  | 5.4        | 2.5       | 8.6     | 81.5       | 36.6      | 26.7    |
| 1392     | 45.3  | 4.5        | 1.5       | 68.3    | 24.0       | 31.4      | 31.8    |
| 3764     | 45.3  | 5.0        | 2.0       | 33.5    | 57.9       | 36.3      | 23.6    |
| 3491     | 45.3  | 5.5        | 2.4       | 9.3     | 80.7       | 33.8      | 28.9    |
| 2170     | 45.3  | 4.2        | 1.3       | 68.9    | 24.2       | 27.0      | 34.5    |
| 470      | 45.3  | 4.0        | 1.4       | 74.0    | 18.9       | 39.5      | 25.4    |
| 4576     | 45.3  | 5.5        | 2.2       | 8.2     | 82.3       | 41.9      | 18.8    |
| 923      | 45.3  | 5.4        | 1.8       | 11.3    | 79.1       |           |         |
| 4602     | 45.3  | 5.6        | 1.5       | 9.1     | 81.7       | 33.1      | 30.7    |
| 3015     | 45.3  | 4.2        | 1.9       | 74.6    | 17.7       | 37.3      | 25.1    |
| 4617     | 45.3  | 6.1        | 1.7       | 10.1    | 80.1       | 35.6      | 28.7    |
| 1387     | 45.3  | 4.6        |           | 69.5    | 23.9       | 29.2      | 32.6    |
| 3342     | 45.3  | 3.5        | 1.6       | 77.7    | 15.5       | 28.8      | 35.6    |
| 3052     | 45.2  | 4.0        | 1.5       | 75.9    | 17.0       | 28.0      | 35.9    |
| 578      | 45.2  | 5.2        | 1.8       | 9.8     | 81.9       | 36.5      | 30.9    |
| 4464     | 45.2  | 4.7        | 1.6       | 9.7     | 82.2       | 39.5      | 25.3    |
| 4594     | 45.2  | 5.9        | 1.6       | 8.6     | 82.0       | 36.3      | 30.4    |
| 3016     | 45.1  | 4.2        | 1.8       | 76.2    | 16.2       | 37.7      | 25.9    |
| 2171     | 45.1  | 4.1        | 1.2       | 69.4    | 23.9       | 24.9      | 36.4    |
| 3383     | 45.1  | 5.4        | 1.7       | 7.6     | 83.4       | 41.9      | 22.1    |
| 2770     | 45.1  | 5.2        | 2.2       | 7.4     | 83.2       | 29.5      | 33.3    |
| 2863     | 45.1  | 6.2        | 1.5       | 8.1     | 82.0       | 35.8      | 24.6    |
| 4752     | 45.1  | 4.1        | 1.5       | 75.2    | 17.6       | 24.2      | 40.2    |
| 3025     | 45.1  | 5.2        | 1.7       | 8.2     | 83.0       | 38.8      | 25.2    |
| 1734     | 45.1  | 4.4        | 1.4       | 72.9    | 19.6       | 34.2      | 27.4    |
| 2773     | 45.1  | 5.3        | 2.1       | 7.3     | 83.1       | 29.5      | 32.1    |
| 2864     | 45.1  | 6.1        | 1.5       | 7.6     | 82.5       | 32.4      | 27.5    |
| 636      | 45.1  | 5.3        | 1.9       | 9.3     | 82.0       | 37.5      | 26.1    |
| 2174     | 45.0  | 4.1        | 1.2       | 71.5    | 21.6       | 25.5      | 36.8    |
| 4670     | 45.0  | 4.2        | 1.3       | 71.9    | 21.0       | 27.7      | 38.0    |
| 4621     | 45.0  | 6.1        | 1.7       | 9.0     | 81.1       | 34.4      | 26.6    |
| 835      | 45.0  | 5.7        | 1.7       | 25.9    | 65.3       | 29.4      | 30.8    |
| 4746     | 45.0  | 5.5        | 1.9       | 7.4     | 83.2       | 34.9      | 30.7    |
| 3066     | 45.0  | 5.5        | 2.0       | 9.9     | 80.6       | 34.4      | 29.9    |
| 4543     | 45.0  | 5.9        | 2.0       | 9.0     | 81.3       | 38.4      | 26.8    |
| 3355     | 45.0  | 5.2        | 2.3       | 9.6     | 81.0       | 35.3      | 30.0    |
| 4152     | 45.0  | 4.3        | 1.3       | 73.5    | 19.2       | 36.0      | 31.0    |
| 389      | 45.0  | 5.9        | 1.9       | 10.1    | 79.9       | 34.7      | 30.0    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4796     | 45.0  | 5.4        | 1.9       | 10.2    | 80.7       | 35.5      | 31.1    |
| 3027     | 45.0  | 5.3        | 1.6       | 8.0     | 83.2       | 37.2      | 22.6    |
| 4422     | 45.0  | 4.2        | 1.5       | 69.8    | 23.0       | 32.2      | 36.0    |
| 3002     | 45.0  | 5.5        | 1.9       | 7.3     | 83.3       | 36.1      | 23.8    |
| 4777     | 45.0  | 6.0        | 1.7       | 8.7     | 81.7       | 33.7      | 32.3    |
| 3114     | 44.9  | 6.0        | 1.7       | 8.5     | 81.7       | 42.9      | 19.2    |
| 4786     | 44.9  | 5.6        | 1.7       | 8.8     | 82.1       | 41.0      | 21.8    |
| 3317     | 44.9  | 5.8        | 1.8       | 10.1    | 80.4       | 33.0      | 29.7    |
| 3402     | 44.9  | 5.1        | 2.3       | 8.9     | 81.7       | 38.9      | 24.1    |
| 4775     | 44.9  | 6.1        | 1.8       | 9.3     | 81.0       | 34.3      | 32.3    |
| 683      | 44.9  | 5.2        | 1.8       | 10.3    | 81.3       | 36.0      | 27.4    |
| 4194     | 44.9  | 5.4        | 1.8       | 7.4     | 83.6       | 33.5      | 29.2    |
| 603      | 44.9  | 5.2        | 1.6       | 9.7     | 82.3       | 32.4      | 29.1    |
| 4766     | 44.9  | 6.1        | 1.8       | 8.3     | 82.1       | 29.9      | 35.2    |
| 771      | 44.9  | 5.6        | 1.6       | 8.6     | 82.7       |           |         |
| 4656     | 44.9  | 5.2        | 2.2       | 8.8     | 82.0       | 36.2      | 28.8    |
| 3388     | 44.9  | 5.1        | 1.8       | 9.0     | 82.2       | 31.5      | 28.4    |
| 2418     | 44.9  | 5.3        | 2.6       | 10.5    | 79.9       | 34.7      | 26.5    |
| 4549     | 44.9  | 4.4        | 1.4       | 74.0    | 18.8       | 26.2      | 36.0    |
| 425      | 44.8  | 5.5        | 1.6       | 9.8     | 81.0       |           |         |
| 2962     | 44.8  | 3.7        | 1.3       | 74.0    | 19.5       | 31.2      | 30.2    |
| 3286     | 44.8  | 5.5        | 1.7       | 9.8     | 81.1       | 35.0      | 26.8    |
| 4615     | 44.8  | 4.2        | 1.7       | 73.1    | 19.5       | 31.7      | 31.4    |
| 3507     | 44.8  | 5.3        | 2.0       | 7.2     | 83.8       | 40.0      | 27.7    |
| 4547     | 44.8  | 3.6        | 1.2       | 78.4    | 14.9       | 29.2      | 31.0    |
| 2133     | 44.8  | 5.0        | 2.0       | 8.8     | 82.7       | 36.3      | 24.7    |
| 856      | 44.8  | 4.0        | 1.1       | 70.5    | 22.9       | 41.5      | 20.1    |
| 3982     | 44.8  | 4.2        | 1.7       | 68.9    | 23.5       | 37.6      | 21.7    |
| 1409     | 44.8  | 4.2        | 1.5       | 75.5    | 17.3       | 41.7      | 15.7    |
| 3503     | 44.8  | 5.3        | 2.1       | 7.2     | 83.4       | 38.6      | 24.7    |
| 551      | 44.8  | 4.5        | 1.7       | 9.8     | 82.7       | 37.3      | 28.6    |
| 3409     | 44.8  | 5.2        | 2.4       | 8.8     | 81.6       | 41.6      | 21.3    |
| 4198     | 44.8  | 5.4        | 1.8       | 7.9     | 83.0       | 32.4      | 29.6    |
| 2861     | 44.8  | 6.1        | 1.6       | 7.9     | 82.2       | 36.1      | 24.9    |
| 4591     | 44.8  | 5.9        | 1.6       | 8.2     | 82.3       | 37.1      | 28.3    |
| 2907     | 44.8  | 4.6        | 1.7       | 33.6    | 58.6       | 31.9      | 31.1    |
| 604      | 44.8  | 5.3        | 1.5       | 10.1    | 81.7       | 32.0      | 30.9    |
| 767      | 44.8  | 5.7        | 1.9       | 9.5     | 81.3       | 34.4      | 32.6    |
| 4443     | 44.8  | 5.3        | 2.1       | 10.2    | 80.4       | 39.0      | 24.9    |
| 2702     | 44.8  | 5.4        | 2.2       | 6.7     | 83.7       | 30.3      | 33.2    |
| 237      | 44.8  | 6.1        | 1.6       | 9.0     | 81.5       | 40.3      | 23.9    |
| 1026     | 44.8  | 5.8        | 1.8       | 9.5     | 80.8       | 35.3      | 30.9    |



HIGH PROTEIN  
LINES



| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4344     | 43.9  | 5.3        | 1.8       | 9.2     | 81.7       | 47.7      | 13.2    |
| 408      | 39.1  | 5.4        | 1.8       | 9.9     | 80.7       | 47.6      | 10.5    |
| 413      | 41.3  | 5.3        | 1.8       | 10.0    | 80.8       | 47.5      | 13.5    |
| 414      | 42.4  | 5.3        | 1.8       | 10.1    | 80.8       | 46.6      | 14.6    |
| 3662     | 35.9  | 5.2        | 2.1       | 8.0     | 82.7       | 45.8 *    | 11.2    |
| 3438     | 43.3  | 4.8        | 2.6       | 8.2     | 82.4       | 44.9      | 15.3    |
| 1663     | 42.8  | 5.3        | 2.2       | 9.5     | 81.1       | 44.9      | 14.4    |
| 1721     | 42.8  | 5.5        | 1.9       | 9.2     | 81.6       | 44.6      | 18.1    |
| 1687     | 42.7  | 5.6        | 1.9       | 9.3     | 81.5       | 44.3      | 16.5    |
| 1712     | 42.9  | 5.4        | 1.8       | 11.3    | 79.6       | 44.1      | 17.0    |
| 3441     | 44.5  | 4.9        | 2.9       | 11.5    | 78.7       | 44.1      | 15.1    |
| 4074     | 44.0  | 5.2        | 2.2       | 7.4     | 83.0       | 43.9      | 17.8    |
| 255      | 42.1  | 5.5        | 1.9       | 10.0    | 80.7       | 43.9      | 18.2    |
| 576      | 47.3  | 4.9        | 1.6       | 9.6     | 82.2       | 43.9      | 18.1    |
| 1724     | 42.5  | 5.4        | 1.6       | 9.2     | 82.1       | 43.8      | 19.9    |
| 585      | 48.1  | 5.1        | 1.8       | 9.6     | 82.2       | 43.6      | 20.9    |
| 4737     | 42.7  | 5.1        | 2.1       | 8.8     | 81.9       | 43.4      | 21.4    |
| 248      | 41.5  | 5.4        | 1.8       | 9.3     | 81.2       | 43.1      | 18.8    |
| 4349     | 44.5  | 5.4        | 1.9       | 8.8     | 81.9       | 43.0      | 17.9    |
| 3114     | 44.9  | 6.0        | 1.7       | 8.5     | 81.7       | 42.9      | 19.2    |
| 869      | 42.8  | 3.8        | 1.3       | 73.5    | 19.8       | 42.7      | 18.8    |
| 4162     | 42.0  | 4.8        | 2.8       | 9.4     | 81.0       | 42.6      | 22.6    |
| 4166     | 43.0  | 4.7        | 2.9       | 9.3     | 81.2       | 42.6      | 22.3    |
| 2852     | 45.3  | 5.1        | 1.8       | 10.3    | 80.9       | 42.5      | 21.3    |
| 2208     | 45.7  | 4.9        | 1.9       | 9.8     | 81.9       | 42.4      | 21.9    |
| 4009     | 45.7  | 5.0        | 2.2       | 8.1     | 82.9       | 42.4      | 16.1    |
| 577      | 46.9  | 5.3        | 1.8       | 9.5     | 81.8       | 42.4      | 18.6    |
| 417      | 42.3  | 5.3        | 1.9       | 8.9     | 81.9       | 42.4      | 20.6    |
| 1833     | 46.9  | 5.5        | 1.9       | 9.8     | 81.5       | 42.3      | 20.9    |
| 545      | 44.4  | 4.8        | 1.7       | 10.0    | 82.3       | 42.3      | 23.2    |
| 666      | 42.8  | 5.6        | 1.9       | 9.7     | 81.0       | 42.2      | 19.5    |
| 1707     | 40.8  | 5.6        | 1.9       | 10.1    | 80.5       | 42.1      | 19.1    |
| 1683     | 43.2  | 5.6        | 1.9       | 9.7     | 80.9       | 42.0      | 18.0    |
| 3178     | 47.8  | 5.5        | 1.8       | 9.4     | 81.1       | 42.0      | 20.8    |
| 1706     | 41.8  | 5.5        | 1.5       | 9.4     | 81.6       | 41.9      | 15.0    |
| 4576     | 45.3  | 5.5        | 2.2       | 8.2     | 82.3       | 41.9      | 18.8    |
| 3383     | 45.1  | 5.4        | 1.7       | 7.6     | 83.4       | 41.9      | 22.1    |
| 1122     | 43.0  | 5.7        | 1.9       | 10.4    | 80.6       | 41.9      | 22.2    |
| 2973     | 41.0  | 5.7        | 1.9       | 9.6     | 80.9       | 41.9      | 20.8    |
| 1672     | 47.6  | 5.3        | 2.0       | 8.9     | 81.9       | 41.8      | 17.2    |
| 4163     | 42.5  | 4.8        | 2.9       | 9.2     | 81.3       | 41.7      | 23.2    |
| 1409     | 44.8  | 4.2        | 1.5       | 75.5    | 17.3       | 41.7      | 15.7    |
| 3931     | 48.8  | 4.2        | 1.4       | 75.5    | 17.4       | 41.7      | 20.2    |
| 1336     | 46.4  | 4.4        | 1.7       | 70.9    | 21.1       | 41.7      | 24.1    |
| 3401     | 44.3  | 5.4        | 2.4       | 8.8     | 81.4       | 41.7      | 20.2    |
| 2158     | 46.1  | 5.3        | 1.8       | 10.0    | 81.3       | 41.6      | 18.5    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 3409     | 44.8  | 5.2        | 2.4       | 8.8     | 81.6       | 41.6      | 21.3    |
| 3382     | 44.5  | 5.3        | 1.7       | 8.3     | 82.8       | 41.6      | 20.4    |
| 583      | 43.5  | 5.0        | 1.8       | 8.6     | 83.3       | 41.5      | 22.2    |
| 856      | 44.8  | 4.0        | 1.1       | 70.5    | 22.9       | 41.5      | 20.1    |
| 4164     | 42.4  | 4.8        | 2.9       | 9.4     | 81.2       | 41.5      | 23.6    |
| 3408     | 41.3  | 5.3        | 2.3       | 8.9     | 81.5       | 41.5      | 22.3    |
| 4736     | 43.7  | 5.1        | 1.9       | 8.9     | 82.1       | 41.4      | 24.5    |
| 4495     | 41.4  | 5.3        | 2.3       | 9.3     | 80.9       | 41.3      | 21.9    |
| 2156     | 44.1  | 5.4        | 1.9       | 9.8     | 81.5       | 41.3      | 17.8    |
| 4643     | 43.7  | 4.7        | 1.9       | 8.4     | 83.2       | 41.3      | 23.6    |
| 2403     | 40.8  | 4.0        | 1.5       | 72.4    | 20.3       | 41.3      | 20.1    |
| 824      | 44.2  | 5.3        | 1.6       | 9.3     | 82.2       | 41.2      | 19.9    |
| 416      | 41.7  | 5.3        | 1.7       | 9.5     | 81.3       | 41.2      | 21.8    |
| 4394     | 44.4  | 5.1        | 2.5       | 8.5     | 82.0       | 41.2      | 23.8    |
| 550      | 45.9  | 5.0        | 1.8       | 10.3    | 81.6       | 41.1      | 22.9    |
| 254      | 42.5  | 5.4        | 1.9       | 10.1    | 80.7       | 41.1      | 21.0    |
| 2207     | 45.8  | 4.9        | 1.9       | 9.6     | 82.2       | 41.1      | 24.3    |
| 3495     | 41.9  | 5.5        | 2.0       | 9.0     | 81.3       | 41.1      | 20.6    |
| 448      | 48.2  | 5.0        | 2.3       | 8.3     | 82.8       | 41.1      | 21.1    |
| 4568     | 49.1  | 4.2        | 2.5       | 72.3    | 19.5       | 41.1      | 23.9    |
| 3117     | 43.6  | 5.3        | 1.9       | 9.5     | 81.1       | 41.0      | 24.2    |
| 1830     | 43.2  | 5.6        | 1.7       | 9.8     | 81.5       | 41.0      | 20.2    |
| 4786     | 44.9  | 5.6        | 1.7       | 8.8     | 82.1       | 41.0      | 21.8    |
| 4626     | 41.8  | 5.0        | 2.0       | 7.4     | 83.7       | 41.0      | 26.3    |
| 3004     | 42.4  | 5.6        | 2.1       | 8.6     | 81.9       | 41.0      | 20.0    |
| 378      | 42.7  | 5.3        | 1.8       | 10.2    | 80.4       | 41.0      | 19.5    |
| 3367     | 43.8  | 5.4        | 2.2       | 7.8     | 82.7       | 41.0      | 22.5    |
| 4822     | 44.6  | 4.4        | 1.5       | 69.0    | 23.7       | 40.8      | 21.6    |
| 3930     | 50.2  | 3.9        | 1.3       | 76.4    | 16.9       | 40.8      | 18.9    |
| 210      | 40.3  | 4.1        | 1.3       | 72.5    | 20.4       | 40.8      | 18.0    |
| 4648     | 43.0  | 5.0        | 2.1       | 9.7     | 81.3       | 40.8      | 24.9    |
| 822      | 44.4  | 5.4        | 1.8       | 8.9     | 82.4       | 40.8      | 23.1    |
| 917      | 42.0  | 5.6        | 1.6       | 8.7     | 82.2       | 40.8      | 23.1    |
| 4845     | 42.2  | 5.0        | 1.8       | 11.0    | 80.3       | 40.8      | 23.0    |
| 385      | 41.0  | 4.8        | 1.6       | 9.4     | 82.2       | 40.7      | 19.3    |
| 4010     | 46.5  | 5.1        | 2.2       | 8.0     | 82.8       | 40.7      | 18.7    |
| 4330     | 46.3  | 4.4        | 1.5       | 37.5    | 55.4       | 40.7      | 26.9    |
| 3846     | 41.7  | 4.8        | 2.5       | 8.5     | 82.1       | 40.6      | 24.1    |
| 418      | 42.5  | 5.3        | 1.9       | 8.4     | 82.4       | 40.5      | 21.0    |
| 581      | 43.3  | 5.1        | 1.6       | 9.4     | 82.6       | 40.5      | 21.8    |
| 3794     | 43.9  | 5.8        | 1.8       | 8.8     | 81.8       | 40.5      | 22.1    |
| 4257     | 41.2  | 5.8        | 1.7       | 9.0     | 81.6       | 40.5      | 19.3    |
| 4167     | 41.8  | 4.7        | 2.7       | 9.1     | 81.6       | 40.5      | 26.6    |
| 3497     | 43.8  | 5.3        | 2.1       | 7.8     | 83.0       | 40.4      | 25.8    |
| 544      | 45.8  | 4.9        | 2.1       | 9.8     | 81.9       | 40.4      | 21.4    |
| 372      | 41.6  | 4.8        | 1.5       | 9.7     | 81.6       | 40.4      | 16.0    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 3670     | 37.9  | 4.9        | 1.6       | 57.2    | 34.8       | 40.4 *    | 15.3    |
| 3363     | 43.0  | 5.2        | 2.1       | 7.0     | 83.8       | 40.4      | 20.3    |
| 2972     | 42.4  | 5.6        | 1.9       | 9.2     | 81.5       | 40.3      | 22.9    |
| 4258     | 46.9  | 5.6        | 1.7       | 8.4     | 82.4       | 40.3      | 31.1    |
| 2077     | 41.6  | 5.5        | 2.1       | 10.1    | 80.9       | 40.3      | 18.7    |
| 1656     | 41.5  | 5.4        | 2.1       | 9.3     | 81.5       | 40.3      | 21.0    |
| 486      | 43.9  | 5.3        | 2.0       | 10.3    | 80.7       | 40.3      | 21.7    |
| 4186     | 41.8  | 5.3        | 2.1       | 9.0     | 81.8       | 40.3      | 26.4    |
| 237      | 44.8  | 6.1        | 1.6       | 9.0     | 81.5       | 40.3      | 23.9    |
| 2157     | 44.3  | 5.3        | 1.8       | 9.7     | 81.6       | 40.3      | 18.9    |
| 4764     | 44.7  | 5.3        | 1.9       | 9.9     | 81.0       | 40.2      | 23.1    |
| 513      | 40.8  | 5.1        | 1.5       | 9.0     | 82.6       | 40.2      | 21.7    |
| 3823     | 40.5  | 5.2        | 2.0       | 8.3     | 82.8       | 40.2      | 26.5    |
| 4165     | 41.9  | 4.8        | 2.9       | 9.4     | 81.0       | 40.2      | 24.2    |
| 211      | 46.1  | 3.5        | 1.2       | 79.5    | 13.9       | 40.1      | 18.6    |
| 3403     | 46.0  | 5.1        | 2.1       | 8.5     | 82.4       | 40.1      | 22.9    |
| 3227     | 45.4  | 6.0        | 2.0       | 7.6     | 82.4       | 40.1      | 23.6    |
| 377      | 40.9  | 5.0        | 1.7       | 9.8     | 81.2       | 40.1      | 21.2    |
| 4334     | 47.7  | 4.9        | 1.8       | 8.0     | 83.5       | 40.1      | 23.9    |
| 238      | 46.3  | 6.2        | 1.7       | 8.6     | 81.6       | 40.1      | 21.3    |
| 4869     | 41.7  | 5.7        | 1.4       | 9.1     | 82.0       | 40.1      | 22.9    |
| 4867     | 46.3  | 5.2        | 1.8       | 10.8    | 80.6       | 40.1      | 24.2    |
| 471      | 46.1  | 4.1        | 1.5       | 74.7    | 18.2       | 40.1      | 22.5    |
| 256      | 42.2  | 5.2        | 1.8       | 10.4    | 80.5       | 40.0      | 22.9    |
| 2985     | 47.0  | 4.1        | 1.4       | 76.9    | 15.9       | 40.0      | 23.1    |
| 4338     | 44.4  | 5.3        | 2.3       | 8.8     | 81.8       | 40.0      | 22.4    |
| 514      | 45.6  | 5.5        | 1.7       | 9.1     | 82.0       | 40.0      | 20.8    |
| 3507     | 44.8  | 5.3        | 2.0       | 7.2     | 83.8       | 40.0      | 27.7    |
| 1710     | 40.0  | 5.3        | 1.6       | 9.6     | 81.8       | 40.0      | 21.2    |
| 1787     | 41.1  | 5.5        | 2.2       | 9.0     | 81.6       | 40.0      | 20.0    |
| 849      | 40.7  | 5.8        | 2.1       | 8.8     | 81.9       | 40.0      | 21.5    |
| 244      | 44.3  | 6.3        | 1.7       | 8.4     | 81.8       | 39.9      | 19.9    |
| 3986     | 44.4  | 4.1        | 1.5       | 70.6    | 22.1       | 39.9      | 23.2    |
| 1790     | 42.8  | 5.7        | 2.6       | 10.4    | 79.6       | 39.9      | 20.1    |
| 374      | 42.0  | 5.0        | 1.6       | 9.9     | 81.2       | 39.9      | 22.7    |
| 785      | 46.4  | 5.4        | 2.1       | 9.9     | 80.9       | 39.9      | 23.3    |
| 4254     | 42.9  | 5.9        | 1.8       | 9.1     | 81.3       | 39.9      | 21.2    |
| 3829     | 44.3  | 5.4        | 2.0       | 7.0     | 83.6       | 39.9      | 30.3    |
| 4406     | 44.3  | 5.5        | 1.9       | 9.0     | 81.6       | 39.8      | 23.3    |
| 375      | 40.3  | 5.1        | 1.7       | 10.1    | 80.7       | 39.8      | 21.4    |
| 3536     | 46.0  | 5.0        | 1.9       | 8.0     | 82.9       | 39.8      | 27.7    |
| 376      | 41.5  | 4.9        | 1.6       | 9.4     | 81.4       | 39.8      | 20.6    |
| 3851     | 40.9  | 5.2        | 2.3       | 8.3     | 82.3       | 39.8      | 28.0    |
| 4647     | 43.9  | 5.3        | 2.1       | 9.6     | 81.1       | 39.8      | 25.2    |
| 3007     | 41.2  | 5.8        | 1.9       | 8.4     | 82.0       | 39.8      | 19.5    |
| 394      | 40.6  | 5.4        | 2.2       | 9.4     | 80.6       | 39.8      | 21.0    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 3465     | 40.0  | 6.3        | 1.8       | 8.0     | 81.8       | 39.8      | 21.1    |
| 1349     | 42.1  | 5.6        | 1.9       | 9.2     | 80.7       | 39.8      | 26.8    |
| 4570     | 48.4  | 6.1        | 3.0       | 8.6     | 80.4       | 39.8      | 21.5    |
| 4723     | 44.3  | 5.9        | 2.0       | 9.7     | 80.4       | 39.8      | 17.9    |
| 1423     | 41.9  | 5.5        | 1.8       | 11.2    | 79.8       | 39.8      | 19.4    |
| 415      | 43.5  | 5.7        | 2.0       | 9.7     | 80.7       | 39.8      | 20.2    |
| 711      | 44.3  | 5.3        | 1.9       | 9.2     | 81.5       | 39.8      | 22.8    |
| 4855     | 41.8  | 4.0        | 1.9       | 69.3    | 22.7       | 39.8      | 24.1    |
| 3531     | 41.5  | 5.5        | 1.8       | 7.5     | 83.2       | 39.7      | 25.5    |
| 3535     | 41.8  | 5.5        | 1.9       | 7.9     | 82.7       | 39.7      | 24.8    |
| 4252     | 46.7  | 6.3        | 1.5       | 7.3     | 82.8       | 39.7      | 18.4    |
| 3404     | 44.0  | 5.3        | 2.0       | 8.9     | 81.9       | 39.7      | 24.2    |
| 4516     | 44.1  | 5.1        | 1.9       | 8.9     | 82.4       | 39.7      | 25.3    |
| 3405     | 42.1  | 5.3        | 2.0       | 8.7     | 82.0       | 39.6      | 24.7    |
| 515      | 44.1  | 5.0        | 1.6       | 9.6     | 81.5       | 39.6      | 21.6    |
| 3530     | 42.5  | 5.5        | 1.8       | 7.6     | 82.9       | 39.6      | 24.9    |
| 1631     | 47.8  | 5.2        | 1.9       | 7.9     | 82.4       | 39.6      | 17.6    |
| 3467     | 41.2  | 6.2        | 1.9       | 8.5     | 81.3       | 39.6      | 20.4    |
| 526      | 16.6  | 5.1        | 2.1       | 8.7     | 82.5       | 39.6      | 18.7    |
| 1751     | 42.6  | 5.5        | 1.7       | 8.6     | 82.9       | 39.6      | 23.1    |
| 798      | 43.7  | 5.3        | 1.7       | 9.6     | 81.0       | 39.6      | 23.4    |
| 649      | 42.8  | 5.1        | 1.8       | 8.3     | 83.6       | 39.6      | 21.9    |
| 1408     | 45.5  | 4.8        | 1.8       | 42.8    | 49.0       | 39.6      | 19.3    |
| 470      | 45.3  | 4.0        | 1.4       | 74.0    | 18.9       | 39.5      | 25.4    |
| 574      | 43.3  | 5.3        | 1.7       | 9.0     | 82.6       | 39.5      | 23.3    |
| 4726     | 48.3  | 5.7        | 1.8       | 8.5     | 82.0       | 39.5      | 23.2    |
| 4788     | 49.9  | 4.1        | 1.7       | 73.6    | 19.0       | 39.5      | 23.2    |
| 4763     | 44.6  | 5.3        | 1.9       | 10.3    | 80.5       | 39.5      | 22.2    |
| 4464     | 45.2  | 4.7        | 1.6       | 9.7     | 82.2       | 39.5      | 25.3    |
| 4622     | 49.2  | 5.8        | 2.0       | 26.1    | 64.6       | 39.5      | 21.6    |
| 474      | 43.6  | 5.7        | 1.9       | 9.6     | 81.0       | 39.5      | 22.7    |
| 4761     | 48.6  | 5.7        | 1.6       | 9.4     | 81.4       | 39.5      | 18.2    |
| 4565     | 40.1  | 5.3        | 1.8       | 9.3     | 81.7       | 39.4      | 27.9    |
| 2447     | 0.0   | 5.1        | 2.4       | 8.6     | 81.6       | 39.4      | 23.0    |
| 3118     | 43.5  | 5.1        | 1.8       | 9.4     | 81.7       | 39.4      | 25.2    |
| 447      | 46.4  | 5.0        | 2.3       | 8.6     | 82.5       | 39.4      | 25.2    |
| 442      | 47.2  | 5.2        | 2.4       | 7.2     | 83.6       | 39.4      | 19.4    |
| 1669     | 39.9  | 5.5        | 1.7       | 8.3     | 82.6       | 39.3      | 22.7    |
| 2081     | 42.2  | 5.6        | 2.1       | 10.0    | 80.9       | 39.3      | 20.9    |
| 1541     | 43.9  | 4.1        | 1.0       | 69.7    | 23.6       | 39.3      | 19.7    |
| 421      | 40.9  | 5.3        | 1.8       | 9.1     | 81.7       | 39.3      | 24.2    |
| 258      | 40.5  | 5.2        | 1.7       | 10.3    | 80.9       | 39.2      | 24.1    |
| 878      | 45.4  | 5.8        | 1.7       | 8.4     | 82.6       | 39.2      | 25.7    |
| 1694     | 42.5  | 5.6        | 1.8       | 9.2     | 81.7       | 39.2      | 21.9    |
| 1807     | 41.9  | 5.4        | 2.2       | 9.0     | 81.9       | 39.2      | 18.1    |
| 3027     | 45.0  | 5.3        | 1.6       | 8.0     | 83.2       | 39.2      | 22.6    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4407     | 44.6  | 5.1        | 1.8       | 8.5     | 82.5       | 39.2      | 26.5    |
| 4007     | 41.7  | 4.7        | 1.8       | 10.2    | 81.4       | 39.2      | 23.4    |
| 3793     | 44.5  | 5.7        | 1.7       | 8.6     | 82.1       | 39.2      | 23.1    |
| 446      | 48.5  | 5.1        | 2.4       | 8.0     | 82.9       | 39.2      | 21.4    |
| 3082     | 43.5  | 5.7        | 2.1       | 8.5     | 81.5       | 39.2      | 25.9    |
| 677      | 47.7  | 5.3        | 1.8       | 9.6     | 82.0       | 39.2      | 23.1    |
| 1367     | 47.2  | 5.7        | 1.8       | 8.8     | 82.2       | 39.1      | 20.7    |
| 634      | 46.7  | 5.1        | 2.0       | 8.6     | 82.9       | 39.1      | 22.2    |
| 1425     | 43.6  | 5.4        | 1.6       | 9.8     | 81.7       | 39.1      | 21.2    |
| 2402     | 42.3  | 4.0        | 1.4       | 72.7    | 20.0       | 39.1      | 23.0    |
| 4857     | 37.7  | 4.1        | 1.9       | 68.9    | 23.0       | 39.1      | 25.5    |
| 3458     | 45.7  | 5.8        | 1.7       | 8.3     | 82.2       | 39.1      | 21.8    |
| 3291     | 49.3  | 5.9        | 1.7       | 9.1     | 81.4       | 39.1      | 20.3    |
| 2149     | 39.5  | 5.0        | 2.0       | 9.4     | 82.3       | 39.0      | 24.1    |
| 2049     | 33.8  | 5.5        | 1.7       | 9.0     | 82.2       | 39.0      | 18.6    |
| 4443     | 44.8  | 5.3        | 2.1       | 10.2    | 80.4       | 39.0      | 24.9    |
| 530      | 42.6  | 5.2        | 1.6       | 8.8     | 83.0       | 39.0      | 20.8    |
| 4789     | 50.2  | 4.1        | 1.7       | 72.8    | 19.6       | 39.0      | 21.2    |
| 449      | 47.7  | 5.0        | 2.3       | 8.3     | 82.9       | 39.0      | 23.9    |
| 3186     | 42.2  | 4.6        | 1.7       | 68.5    | 23.6       | 39.0      | 23.7    |
| 356      | 40.9  | 4.9        | 1.9       | 8.5     | 82.4       | 39.0      | 23.3    |
| 4731     | 46.0  | 5.3        | 1.6       | 9.1     | 82.0       | 38.9      | 24.3    |
| 257      | 43.2  | 5.3        | 1.7       | 10.2    | 80.8       | 38.9      | 27.1    |
| 3402     | 44.9  | 5.1        | 2.3       | 8.9     | 81.7       | 38.9      | 24.1    |
| 212      | 47.0  | 3.6        | 1.3       | 80.8    | 12.4       | 38.9      | 19.1    |
| 334      | 39.9  | 5.5        | 1.7       | 8.3     | 82.1       | 38.9      | 25.5    |
| 3496     | 40.4  | 5.3        | 2.1       | 7.3     | 83.4       | 38.9      | 27.3    |
| 274      | 49.0  | 4.5        | 1.6       | 71.1    | 21.2       | 38.9      | 23.5    |
| 3498     | 43.0  | 5.3        | 2.0       | 7.4     | 83.3       | 38.9      | 23.9    |
| 3844     | 41.9  | 5.0        | 2.5       | 9.6     | 80.8       | 38.9      | 28.0    |
| 725      | 42.0  | 5.5        | 1.7       | 9.3     | 81.8       | 38.9      | 24.8    |
| 4732     | 47.3  | 5.5        | 1.9       | 9.7     | 80.9       | 38.9      | 23.9    |
| 4618     | 43.8  | 5.9        | 1.8       | 10.4    | 79.9       | 38.9      | 23.8    |
| 533      | 40.4  | 5.0        | 1.8       | 8.8     | 83.1       | 38.8      | 21.3    |
| 3468     | 42.0  | 6.2        | 1.9       | 8.4     | 81.4       | 38.8      | 22.5    |
| 3392     | 40.8  | 5.8        | 1.6       | 8.8     | 81.7       | 38.8      | 20.7    |
| 243      | 43.8  | 6.2        | 1.7       | 9.2     | 81.1       | 38.8      | 20.7    |
| 4437     | 45.7  | 4.9        | 1.9       | 9.0     | 82.4       | 38.8      | 22.5    |
| 4545     | 41.4  | 4.9        | 1.5       | 9.2     | 82.8       | 38.8      | 24.2    |
| 3025     | 45.1  | 5.2        | 1.7       | 8.2     | 83.0       | 38.8      | 25.2    |
| 3709     | 42.7  | 5.6        | 1.7       | 9.4     | 81.4       | 38.8      | 25.0    |
| 4646     | 46.6  | 5.7        | 2.9       | 9.5     | 80.0       | 38.8      | 23.4    |
| 3504     | 43.1  | 5.1        | 2.2       | 7.2     | 83.6       | 38.8      | 24.6    |
| 364      | 40.6  | 4.8        | 2.0       | 8.0     | 83.2       | 38.8      | 27.7    |
| 3407     | 43.0  | 5.0        | 2.5       | 9.8     | 80.7       | 38.7      | 27.0    |
| 4255     | 42.5  | 5.7        | 1.7       | 9.0     | 81.7       | 38.7      | 23.0    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 527      | 41.2  | 4.9        | 1.8       | 8.9     | 82.8       | 38.7      | 21.2    |
| 4114     | 40.0  | 5.1        | 1.9       | 8.8     | 82.2       | 38.7      | 28.3    |
| 3344     | 43.2  | 5.3        | 1.7       | 9.0     | 82.1       | 38.7      | 26.8    |
| 4188     | 42.2  | 5.3        | 2.0       | 8.8     | 82.1       | 38.6      | 29.0    |
| 3503     | 44.8  | 5.3        | 2.1       | 7.2     | 83.4       | 38.6      | 24.7    |
| 1714     | 38.1  | 5.1        | 1.7       | 9.5     | 81.9       | 38.6      | 26.0    |
| 684      | 44.6  | 5.2        | 1.8       | 10.6    | 81.0       | 38.6      | 25.5    |
| 2845     | 47.6  | 5.9        | 1.8       | 9.3     | 81.2       | 38.5      | 22.1    |
| 2616     | 42.4  | 5.9        | 1.9       | 9.7     | 80.4       | 38.5      | 29.6    |
| 795      | 43.4  | 5.2        | 1.9       | 10.4    | 81.0       | 38.5      | 26.4    |
| 3083     | 43.5  | 5.5        | 1.9       | 7.8     | 82.7       | 38.5      | 24.0    |
| 3533     | 41.1  | 5.5        | 1.9       | 7.7     | 83.2       | 38.5      | 25.4    |
| 3470     | 40.7  | 6.2        | 1.8       | 8.3     | 81.8       | 38.5      | 18.4    |
| 488      | 45.4  | 4.9        | 2.2       | 10.6    | 80.4       | 38.5      | 22.0    |
| 4153     | 46.3  | 4.3        | 1.3       | 72.5    | 20.4       | 38.4      | 26.9    |
| 3508     | 44.0  | 5.3        | 2.0       | 7.5     | 83.3       | 38.4      | 25.7    |
| 4548     | 44.3  | 5.4        | 2.3       | 10.0    | 80.4       | 38.4      | 23.0    |
| 1665     | 41.6  | 5.4        | 2.0       | 9.3     | 81.6       | 38.4      | 24.7    |
| 1544     | 41.8  | 5.1        | 2.6       | 9.6     | 81.2       | 38.4      | 26.7    |
| 863      | 35.7  | 4.1        | 1.2       | 76.2    | 16.9       | 38.4      | 21.4    |
| 4543     | 45.0  | 5.9        | 2.0       | 9.0     | 81.3       | 38.4      | 26.8    |
| 3501     | 41.9  | 5.3        | 1.9       | 7.3     | 83.6       | 38.4      | 25.6    |
| 4376     | 43.3  | 5.1        | 2.1       | 8.9     | 82.0       | 38.4      | 27.6    |
| 629      | 43.5  | 5.2        | 1.9       | 9.2     | 82.2       | 38.4      | 20.9    |
| 4564     | 42.3  | 5.3        | 1.8       | 8.7     | 82.2       | 38.4      | 26.6    |
| 3378     | 39.2  | 5.2        | 1.8       | 15.8    | 75.2       | 38.4      | 21.8    |
| 549      | 44.3  | 4.7        | 1.8       | 10.6    | 81.6       | 38.4      | 28.2    |
| 3932     | 50.4  | 3.7        | 1.2       | 79.0    | 15.0       | 38.4      | 23.2    |
| 4649     | 45.4  | 5.4        | 2.8       | 10.1    | 79.7       | 38.3      | 27.5    |
| 4628     | 44.6  | 5.3        | 2.7       | 9.3     | 80.7       | 38.3      | 29.1    |
| 4571     | 47.6  | 5.6        | 2.4       | 9.7     | 80.4       | 38.3      | 23.7    |
| 4284     | 41.3  | 5.8        | 1.6       | 8.8     | 82.0       | 38.3      | 27.7    |
| 444      | 48.8  | 5.0        | 2.2       | 7.6     | 83.5       | 38.3      | 21.9    |
| 4532     | 44.0  | 4.9        | 1.7       | 7.9     | 83.7       | 38.3      | 26.7    |
| 4253     | 47.9  | 6.5        | 1.6       | 7.4     | 82.5       | 38.3      | 19.3    |
| 4596     | 45.6  | 4.9        | 1.9       | 8.6     | 82.8       | 38.3      | 25.4    |
| 3532     | 40.5  | 5.5        | 1.9       | 8.0     | 82.8       | 38.3      | 25.8    |
| 1803     | 39.9  | 5.4        | 1.9       | 9.6     | 81.7       | 38.3      | 20.2    |
| 3389     | 43.9  | 5.3        | 2.1       | 8.2     | 82.4       | 38.3      | 22.3    |
| 3261     | 44.2  | 5.3        | 1.6       | 8.3     | 82.8       | 38.3      | 22.8    |
| 2445     | 41.8  | 5.9        | 1.9       | 8.7     | 81.0       | 38.3      | 26.0    |
| 3722     | 40.8  | 5.4        | 1.6       | 10.9    | 79.9       | 38.3      | 24.4    |
| 2398     | 40.7  | 3.7        | 1.4       | 75.1    | 18.0       | 38.3      | 24.3    |
| 3796     | 44.3  | 5.4        | 2.4       | 8.4     | 81.9       | 38.3      | 25.3    |
| 2449     | 0.0   | 6.0        | 2.2       | 9.3     | 80.0       | 38.3      | 25.9    |
| 4712     | 44.3  | 5.9        | 1.7       | 9.5     | 80.8       | 38.3      | 25.2    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 1685     | 41.7  | 5.3        | 1.8       | 9.3     | 81.9       | 38.3      | 21.5    |
| 3310     | 47.0  | 5.6        | 1.7       | 9.8     | 80.9       | 38.3      | 25.2    |
| 3466     | 41.0  | 6.4        | 1.9       | 8.4     | 81.3       | 38.3      | 20.1    |
| 1569     | 42.8  | 5.5        | 1.6       | 10.3    | 81.2       | 38.3      | 22.9    |
| 4118     | 40.8  | 5.1        | 1.9       | 7.6     | 83.6       | 38.3      | 27.3    |
| 4501     | 47.8  | 5.0        | 1.6       | 9.9     | 81.6       | 38.2      | 22.9    |
| 3461     | 45.6  | 6.0        | 1.7       | 8.2     | 82.1       | 38.2      | 22.9    |
| 4870     | 42.1  | 5.4        | 1.8       | 9.4     | 81.6       | 38.2      | 26.0    |
| 3445     | 31.8  | 5.2        | 1.5       | 8.4     | 83.3       | 38.2      | 27.3    |
| 3537     | 46.3  | 5.1        | 1.8       | 7.4     | 83.6       | 38.2      | 26.9    |
| 273      | 48.7  | 4.5        | 1.7       | 71.5    | 20.6       | 38.2      | 21.8    |
| 2404     | 42.7  | 4.6        | 1.5       | 42.0    | 50.0       | 38.2      | 24.4    |
| 4784     | 45.7  | 5.7        | 1.7       | 8.5     | 82.2       | 38.2      | 24.4    |
| 3390     | 42.7  | 5.5        | 2.3       | 9.1     | 81.1       | 38.2      | 22.5    |
| 4189     | 42.7  | 5.3        | 1.9       | 9.2     | 81.8       | 38.2      | 27.7    |
| 4587     | 40.9  | 5.4        | 2.1       | 9.2     | 81.3       | 38.2      | 26.2    |
| 1834     | 41.9  | 5.5        | 1.7       | 9.9     | 81.5       | 38.2      | 27.2    |
| 3034     | 44.0  | 4.9        | 1.7       | 9.1     | 82.3       | 38.2      | 26.2    |
| 4653     | 44.3  | 5.2        | 2.8       | 9.2     | 81.1       | 38.2      | 28.5    |
| 4521     | 46.9  | 5.1        | 2.2       | 8.2     | 82.6       | 38.2      | 22.1    |
| 3933     | 47.4  | 3.7        | 1.5       | 71.4    | 21.8       | 38.2      | 26.0    |
| 4703     | 44.6  | 4.7        | 1.9       | 10.5    | 81.0       | 38.2      | 26.9    |
| 2491     | 37.9  | 5.4        | 2.8       | 9.8     | 79.3       | 38.1      | 24.6    |
| 3386     | 44.3  | 5.3        | 2.1       | 8.7     | 81.8       | 38.1      | 19.8    |
| 2134     | 42.1  | 5.0        | 2.1       | 9.7     | 81.8       | 38.1      | 23.4    |
| 809      | 48.9  | 5.0        | 2.2       | 8.4     | 83.0       | 38.1      | 24.9    |
| 4156     | 40.0  | 4.8        | 2.9       | 10.6    | 79.9       | 38.1      | 25.7    |
| 3292     | 48.1  | 5.9        | 1.7       | 9.3     | 81.2       | 38.1      | 21.4    |
| 4016     | 39.7  | 5.6        | 1.5       | 10.3    | 80.9       | 38.1      | 23.1    |
| 4072     | 46.0  | 5.3        | 2.1       | 7.8     | 82.8       | 38.1      | 24.4    |
| 4402     | 45.9  | 5.9        | 1.7       | 8.9     | 81.4       | 38.1      | 24.1    |
| 4187     | 42.0  | 5.3        | 2.0       | 8.8     | 82.1       | 38.1      | 28.1    |
| 3366     | 42.0  | 5.2        | 2.2       | 7.2     | 83.5       | 38.1      | 23.9    |
| 3502     | 43.9  | 5.1        | 2.0       | 7.1     | 84.0       | 38.1      | 25.3    |
| 749      | 43.4  | 4.8        | 1.7       | 33.1    | 58.9       | 38.1      | 21.3    |



# LOW FIBER LINES



| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 408      | 39.1  | 5.4        | 1.8       | 9.9     | 80.7       | 47.6      | 10.5    |
| 3662     | 35.9  | 5.2        | 2.1       | 8.0     | 82.7       | 45.8 *    | 11.2    |
| 4344     | 43.9  | 5.3        | 1.8       | 9.2     | 81.7       | 47.7      | 13.2    |
| 413      | 41.3  | 5.3        | 1.8       | 10.0    | 80.8       | 47.5      | 13.5    |
| 1663     | 42.8  | 5.3        | 2.2       | 9.5     | 81.1       | 44.9      | 14.4    |
| 414      | 42.4  | 5.3        | 1.8       | 10.1    | 80.8       | 46.6      | 14.6    |
| 1706     | 41.8  | 5.5        | 1.5       | 9.4     | 81.6       | 41.9      | 15.0    |
| 3441     | 44.5  | 4.9        | 2.9       | 11.5    | 78.7       | 44.1      | 15.1    |
| 3438     | 43.3  | 4.8        | 2.6       | 8.2     | 82.4       | 44.9      | 15.3    |
| 3670     | 37.9  | 4.9        | 1.6       | 57.2    | 34.8       | 40.4 *    | 15.3    |
| 1409     | 44.8  | 4.2        | 1.5       | 75.5    | 17.3       | 41.7      | 15.7    |
| 372      | 41.6  | 4.8        | 1.5       | 9.7     | 81.6       | 40.4      | 16.0    |
| 4009     | 45.7  | 5.0        | 2.2       | 8.1     | 82.9       | 42.4      | 16.1    |
| 1687     | 42.7  | 5.6        | 1.9       | 9.3     | 81.5       | 44.3      | 16.5    |
| 1712     | 42.9  | 5.4        | 1.8       | 11.3    | 79.6       | 44.1      | 17.0    |
| 1672     | 47.6  | 5.3        | 2.0       | 8.9     | 81.9       | 41.8      | 17.2    |
| 1631     | 47.8  | 5.2        | 1.9       | 7.9     | 82.4       | 39.6      | 17.6    |
| 4074     | 44.0  | 5.2        | 2.2       | 7.4     | 83.0       | 43.9      | 17.8    |
| 2156     | 44.1  | 5.4        | 1.9       | 9.8     | 81.5       | 41.3      | 17.8    |
| 4723     | 44.3  | 5.9        | 2.0       | 9.7     | 80.4       | 39.8      | 17.9    |
| 4349     | 44.5  | 5.4        | 1.9       | 8.8     | 81.9       | 43.0      | 17.9    |
| 210      | 40.3  | 4.1        | 1.3       | 72.5    | 20.4       | 40.8      | 18.0    |
| 1683     | 43.2  | 5.6        | 1.9       | 9.7     | 80.9       | 42.0      | 18.0    |
| 1807     | 41.9  | 5.4        | 2.2       | 9.0     | 81.9       | 39.2      | 18.1    |
| 576      | 47.3  | 4.9        | 1.6       | 9.6     | 82.2       | 43.9      | 18.1    |
| 1721     | 42.8  | 5.5        | 1.9       | 9.2     | 81.6       | 44.6      | 18.1    |
| 255      | 42.1  | 5.5        | 1.9       | 10.0    | 80.7       | 43.9      | 18.2    |
| 4761     | 48.6  | 5.7        | 1.6       | 9.4     | 81.4       | 39.5      | 18.2    |
| 1646     | 48.7  | 4.7        | 1.3       | 66.7    | 25.9       | 37.7      | 18.4    |
| 4252     | 46.7  | 6.3        | 1.5       | 7.3     | 82.8       | 39.7      | 18.4    |
| 3470     | 40.7  | 6.2        | 1.8       | 8.3     | 81.8       | 38.5      | 18.4    |
| 241      | 44.0  | 6.3        | 1.7       | 8.8     | 81.5       | 37.7      | 18.4    |
| 272      | 43.8  | 5.2        | 1.4       | 9.0     | 82.3       | 38.0      | 18.4    |
| 2158     | 46.1  | 5.3        | 1.8       | 10.0    | 81.3       | 41.6      | 18.5    |
| 577      | 46.9  | 5.3        | 1.8       | 9.5     | 81.8       | 42.4      | 18.6    |
| 2049     | 33.8  | 5.5        | 1.7       | 9.0     | 82.2       | 39.0 *    | 18.6    |
| 211      | 46.1  | 3.5        | 1.2       | 79.5    | 13.9       | 40.1      | 18.6    |
| 2077     | 41.6  | 5.5        | 2.1       | 10.1    | 80.9       | 40.3      | 18.7    |
| 4010     | 46.5  | 5.1        | 2.2       | 8.0     | 82.8       | 40.7      | 18.7    |
| 526      | 16.6  | 5.1        | 2.1       | 8.7     | 82.5       | 39.6      | 18.7    |
| 4576     | 45.3  | 5.5        | 2.2       | 8.2     | 82.3       | 41.9      | 18.8    |
| 248      | 41.5  | 5.4        | 1.8       | 9.3     | 81.2       | 43.1      | 18.8    |
| 869      | 42.8  | 3.8        | 1.3       | 73.5    | 19.8       | 42.7      | 18.8    |
| 2157     | 44.3  | 5.3        | 1.8       | 9.7     | 81.6       | 40.3      | 18.9    |
| 3930     | 50.2  | 3.9        | 1.3       | 76.4    | 16.9       | 40.8      | 18.9    |
| 1707     | 40.8  | 5.6        | 1.9       | 10.1    | 80.5       | 42.1      | 19.1    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 212      | 47.0  | 3.6        | 1.3       | 80.8    | 12.4       | 38.9      | 19.1    |
| 3114     | 44.9  | 6.0        | 1.7       | 8.5     | 81.7       | 42.9      | 19.2    |
| 4253     | 47.9  | 6.5        | 1.6       | 7.4     | 82.5       | 38.3      | 19.3    |
| 1408     | 45.5  | 4.8        | 1.8       | 42.8    | 49.0       | 39.6      | 19.3    |
| 385      | 41.0  | 4.8        | 1.6       | 9.4     | 82.2       | 40.7      | 19.3    |
| 4257     | 41.2  | 5.8        | 1.7       | 9.0     | 81.6       | 40.5      | 19.3    |
| 442      | 47.2  | 5.2        | 2.4       | 7.2     | 83.6       | 39.4      | 19.4    |
| 1423     | 41.9  | 5.5        | 1.8       | 11.2    | 79.8       | 39.8      | 19.4    |
| 378      | 42.7  | 5.3        | 1.8       | 10.2    | 80.4       | 41.0      | 19.5    |
| 666      | 42.8  | 5.6        | 1.9       | 9.7     | 81.0       | 42.2      | 19.5    |
| 3007     | 41.2  | 5.8        | 1.9       | 8.4     | 82.0       | 39.8      | 19.5    |
| 1541     | 43.9  | 4.1        | 1.0       | 69.7    | 23.6       | 39.3      | 19.7    |
| 1691     | 48.5  | 5.6        | 1.7       | 8.1     | 83.0       | 37.4      | 19.7    |
| 3386     | 44.3  | 5.3        | 2.1       | 8.7     | 81.8       | 38.1      | 19.8    |
| 244      | 44.3  | 6.3        | 1.7       | 8.4     | 81.8       | 39.9      | 19.9    |
| 1724     | 42.5  | 5.4        | 1.6       | 9.2     | 82.1       | 43.8      | 19.9    |
| 824      | 44.2  | 5.3        | 1.6       | 9.3     | 82.2       | 41.2      | 19.9    |
| 4256     | 42.9  | 5.6        | 1.7       | 8.4     | 82.4       | 37.6      | 19.9    |
| 1787     | 41.1  | 5.5        | 2.2       | 9.0     | 81.6       | 40.0      | 20.0    |
| 3004     | 42.4  | 5.6        | 2.1       | 8.6     | 81.9       | 41.0      | 20.0    |
| 856      | 44.8  | 4.0        | 1.1       | 70.5    | 22.9       | 41.5      | 20.1    |
| 3466     | 41.0  | 6.4        | 1.9       | 8.4     | 81.3       | 38.3      | 20.1    |
| 1790     | 42.8  | 5.7        | 2.6       | 10.4    | 79.6       | 39.9      | 20.1    |
| 1636     | 46.0  | 5.4        | 1.4       | 32.3    | 59.5       | 34.8      | 20.1    |
| 2403     | 40.8  | 4.0        | 1.5       | 72.4    | 20.3       | 41.3      | 20.1    |
| 3931     | 48.8  | 4.2        | 1.4       | 75.5    | 17.4       | 41.7      | 20.2    |
| 1830     | 43.2  | 5.6        | 1.7       | 9.8     | 81.5       | 41.0      | 20.2    |
| 3401     | 44.3  | 5.4        | 2.4       | 8.8     | 81.4       | 41.7      | 20.2    |
| 1803     | 39.9  | 5.4        | 1.9       | 9.6     | 81.7       | 38.3      | 20.2    |
| 415      | 43.5  | 5.7        | 2.0       | 9.7     | 80.7       | 39.8      | 20.2    |
| 3363     | 43.0  | 5.2        | 2.1       | 7.0     | 83.8       | 40.4      | 20.3    |
| 3291     | 49.3  | 5.9        | 1.7       | 9.1     | 81.4       | 39.1      | 20.3    |
| 3467     | 41.2  | 6.2        | 1.9       | 8.5     | 81.3       | 39.6      | 20.4    |
| 3382     | 44.5  | 5.3        | 1.7       | 8.3     | 82.8       | 41.6      | 20.4    |
| 3462     | 41.6  | 6.3        | 1.8       | 8.5     | 81.4       | 37.8      | 20.4    |
| 376      | 41.5  | 4.9        | 1.6       | 9.4     | 81.4       | 39.8      | 20.6    |
| 417      | 42.3  | 5.3        | 1.9       | 8.9     | 81.9       | 42.4      | 20.6    |
| 3495     | 41.9  | 5.5        | 2.0       | 9.0     | 81.3       | 41.1      | 20.6    |
| 3392     | 40.8  | 5.8        | 1.6       | 8.8     | 81.7       | 38.8      | 20.7    |
| 1367     | 47.2  | 5.7        | 1.8       | 8.8     | 82.2       | 39.1      | 20.7    |
| 1615     | 45.4  | 5.6        | 1.5       | 21.5    | 70.0       | 37.6      | 20.7    |
| 243      | 43.8  | 6.2        | 1.7       | 9.2     | 81.1       | 38.8      | 20.7    |
| 1602     | 47.3  | 5.1        | 1.6       | 33.4    | 58.6       | 36.0      | 20.7    |
| 2973     | 41.0  | 5.7        | 1.9       | 9.6     | 80.9       | 41.9      | 20.8    |
| 3178     | 47.8  | 5.5        | 1.8       | 9.4     | 81.1       | 42.0      | 20.8    |
| 514      | 45.6  | 5.5        | 1.7       | 9.1     | 82.0       | 40.0      | 20.8    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 530      | 42.6  | 5.2        | 1.6       | 8.8     | 83.0       | 39.0      | 20.8    |
| 1833     | 46.9  | 5.5        | 1.9       | 9.8     | 81.5       | 42.3      | 20.9    |
| 585      | 48.1  | 5.1        | 1.8       | 9.6     | 82.2       | 43.6      | 20.9    |
| 629      | 43.5  | 5.2        | 1.9       | 9.2     | 82.2       | 38.4      | 20.9    |
| 226      | 42.6  | 5.7        | 2.0       | 8.2     | 82.6       | 37.3      | 20.9    |
| 2081     | 42.2  | 5.6        | 2.1       | 10.0    | 80.9       | 39.3      | 20.9    |
| 394      | 40.6  | 5.4        | 2.2       | 9.4     | 80.6       | 39.8      | 21.0    |
| 1656     | 41.5  | 5.4        | 2.1       | 9.3     | 81.5       | 40.3      | 21.0    |
| 418      | 42.5  | 5.3        | 1.9       | 8.4     | 82.4       | 40.5      | 21.0    |
| 254      | 42.5  | 5.4        | 1.9       | 10.1    | 80.7       | 41.1      | 21.0    |
| 3465     | 40.0  | 6.3        | 1.8       | 8.0     | 81.8       | 39.8      | 21.1    |
| 448      | 48.2  | 5.0        | 2.3       | 8.3     | 82.8       | 41.1      | 21.1    |
| 527      | 41.2  | 4.9        | 1.8       | 8.9     | 82.8       | 38.7      | 21.2    |
| 4769     | 44.4  | 6.1        | 2.0       | 8.1     | 81.8       | 37.4      | 21.2    |
| 1425     | 43.6  | 5.4        | 1.6       | 9.8     | 81.7       | 39.1      | 21.2    |
| 4789     | 50.2  | 4.1        | 1.7       | 72.8    | 19.6       | 39.0      | 21.2    |
| 4254     | 42.9  | 5.9        | 1.8       | 9.1     | 81.3       | 39.9      | 21.2    |
| 1710     | 40.0  | 5.3        | 1.6       | 9.6     | 81.8       | 40.0      | 21.2    |
| 377      | 40.9  | 5.0        | 1.7       | 9.8     | 81.2       | 40.1      | 21.2    |
| 533      | 40.4  | 5.0        | 1.8       | 8.8     | 83.1       | 38.8      | 21.3    |
| 3409     | 44.8  | 5.2        | 2.4       | 8.8     | 81.6       | 41.6      | 21.3    |
| 2852     | 45.3  | 5.1        | 1.8       | 10.3    | 80.9       | 42.5      | 21.3    |
| 238      | 46.3  | 6.2        | 1.7       | 8.6     | 81.6       | 40.1      | 21.3    |
| 749      | 43.4  | 4.8        | 1.7       | 33.1    | 58.9       | 38.1      | 21.3    |
| 1805     | 44.0  | 5.5        | 2.5       | 10.4    | 80.0       | 37.8      | 21.3    |
| 544      | 45.8  | 4.9        | 2.1       | 9.8     | 81.9       | 40.4      | 21.4    |
| 1668     | 41.4  | 5.5        | 2.0       | 9.2     | 81.4       | 37.9      | 21.4    |
| 3292     | 48.1  | 5.9        | 1.7       | 9.3     | 81.2       | 38.1      | 21.4    |
| 863      | 35.7  | 4.1        | 1.2       | 76.2    | 16.9       | 38.4      | 21.4    |
| 375      | 40.3  | 5.1        | 1.7       | 10.1    | 80.7       | 39.8      | 21.4    |
| 446      | 48.5  | 5.1        | 2.4       | 8.0     | 82.9       | 39.2      | 21.4    |
| 4737     | 42.7  | 5.1        | 2.1       | 8.8     | 81.9       | 43.4      | 21.4    |
| 849      | 40.7  | 5.8        | 2.1       | 8.8     | 81.9       | 40.0      | 21.5    |
| 1685     | 41.7  | 5.3        | 1.8       | 9.3     | 81.9       | 39.3      | 21.5    |
| 4570     | 48.4  | 6.1        | 3.0       | 8.6     | 80.4       | 39.8      | 21.5    |
| 4822     | 44.6  | 4.4        | 1.5       | 69.0    | 23.7       | 40.8      | 21.6    |
| 4622     | 49.2  | 5.8        | 2.0       | 26.1    | 64.6       | 39.5      | 21.6    |
| 515      | 44.1  | 5.0        | 1.6       | 9.6     | 81.5       | 39.6      | 21.6    |
| 3982     | 44.8  | 4.2        | 1.7       | 68.9    | 23.5       | 37.6      | 21.7    |
| 486      | 43.9  | 5.3        | 2.0       | 10.3    | 80.7       | 40.3      | 21.7    |
| 513      | 40.8  | 5.1        | 1.5       | 9.0     | 82.6       | 40.2      | 21.7    |
| 273      | 48.7  | 4.5        | 1.7       | 71.5    | 20.6       | 38.2      | 21.8    |
| 581      | 43.3  | 5.1        | 1.6       | 9.4     | 82.6       | 40.5      | 21.8    |
| 1118     | 49.9  | 4.7        | 1.7       | 39.2    | 53.0       | 34.5      | 21.8    |
| 416      | 41.7  | 5.3        | 1.7       | 9.5     | 81.3       | 41.2      | 21.8    |
| 4786     | 44.9  | 5.6        | 1.7       | 8.8     | 82.1       | 41.0      | 21.8    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 3458     | 45.7  | 5.8        | 1.7       | 8.3     | 82.2       | 39.1      | 21.8    |
| 3176     | 43.7  | 5.2        | 1.7       | 8.4     | 82.7       | 37.4      | 21.8    |
| 3378     | 39.2  | 5.2        | 1.8       | 15.8    | 75.2       | 38.4      | 21.8    |
| 649      | 42.8  | 5.1        | 1.8       | 8.3     | 83.6       | 39.6      | 21.9    |
| 2208     | 45.7  | 4.9        | 1.9       | 9.8     | 81.9       | 42.4      | 21.9    |
| 444      | 48.8  | 5.0        | 2.2       | 7.6     | 83.5       | 38.3      | 21.9    |
| 1469     | 42.6  | 5.8        | 1.9       | 10.4    | 80.4       | 38.0      | 21.9    |
| 1694     | 42.5  | 5.6        | 1.8       | 9.2     | 81.7       | 39.2      | 21.9    |
| 4495     | 41.4  | 5.3        | 2.3       | 9.3     | 80.9       | 41.3      | 21.9    |
| 2117     | 47.2  | 4.4        | 1.8       | 69.4    | 22.7       | 36.7      | 22.0    |
| 3469     | 42.7  | 6.1        | 1.8       | 8.1     | 82.0       | 36.0      | 22.0    |
| 488      | 45.4  | 4.9        | 2.2       | 10.6    | 80.4       | 38.5      | 22.0    |
| 591      | 43.9  | 5.1        | 1.5       | 9.7     | 82.5       | 37.1      | 22.1    |
| 3794     | 43.9  | 5.8        | 1.8       | 8.8     | 81.8       | 40.5      | 22.1    |
| 2845     | 47.6  | 5.9        | 1.8       | 9.3     | 81.2       | 38.5      | 22.1    |
| 1192     | 46.6  | 5.7        | 1.7       | 8.3     | 82.8       | 37.0      | 22.1    |
| 4521     | 46.9  | 5.1        | 2.2       | 8.2     | 82.6       | 38.2      | 22.1    |
| 3282     | 44.3  | 5.4        | 2.0       | 9.7     | 80.9       | 38.0      | 22.1    |
| 3383     | 45.1  | 5.4        | 1.7       | 7.6     | 83.4       | 41.9      | 22.1    |
| 4763     | 44.6  | 5.3        | 1.9       | 10.3    | 80.5       | 39.5      | 22.2    |
| 1122     | 43.0  | 5.7        | 1.9       | 10.4    | 80.6       | 41.9      | 22.2    |
| 583      | 43.5  | 5.0        | 1.8       | 8.6     | 83.3       | 41.5      | 22.2    |
| 634      | 46.7  | 5.1        | 2.0       | 8.6     | 82.9       | 39.1      | 22.2    |
| 1604     | 48.6  | 3.8        | 1.4       | 72.5    | 20.7       | 36.8      | 22.2    |
| 3309     | 46.2  | 5.9        | 1.6       | 10.2    | 80.4       | 36.4      | 22.3    |
| 3408     | 41.3  | 5.3        | 2.3       | 8.9     | 81.5       | 41.5      | 22.3    |
| 4166     | 43.0  | 4.7        | 2.9       | 9.3     | 81.2       | 42.6      | 22.3    |
| 3389     | 43.9  | 5.3        | 2.1       | 8.2     | 82.4       | 38.3      | 22.3    |
| 4695     | 46.5  | 5.3        | 1.6       | 7.4     | 83.8       | 37.1      | 22.4    |
| 4338     | 44.4  | 5.3        | 2.3       | 8.8     | 81.8       | 40.0      | 22.4    |
| 305      | 37.2  | 5.2        | 1.6       | 9.8     | 81.0       | 36.6      | 22.4    |
| 1789     | 41.9  | 5.6        | 2.4       | 9.8     | 80.5       | 37.2      | 22.4    |
| 3390     | 42.7  | 5.5        | 2.3       | 9.1     | 81.1       | 38.2      | 22.5    |
| 4277     | 43.1  | 4.1        | 1.4       | 68.2    | 24.8       | 36.3      | 22.5    |
| 471      | 46.1  | 4.1        | 1.5       | 74.7    | 18.2       | 40.1      | 22.5    |
| 3367     | 43.8  | 5.4        | 2.2       | 7.8     | 82.7       | 41.0      | 22.5    |
| 4437     | 45.7  | 4.9        | 1.9       | 9.0     | 82.4       | 38.8      | 22.5    |
| 3468     | 42.0  | 6.2        | 1.9       | 8.4     | 81.4       | 38.8      | 22.5    |
| 2518     | 47.0  | 5.5        | 1.9       | 8.3     | 82.3       | 36.4      | 22.6    |
| 4162     | 42.0  | 4.8        | 2.8       | 9.4     | 81.0       | 42.6      | 22.6    |
| 667      | 43.8  | 5.4        | 1.9       | 10.3    | 80.9       | 38.0      | 22.6    |
| 3027     | 45.0  | 5.3        | 1.6       | 8.0     | 83.2       | 39.2      | 22.6    |
| 117      | 37.6  | 5.7        | 1.8       | 7.2     | 83.2       | 35.8      | 22.6    |
| 1677     | 41.6  | 5.6        | 1.9       | 9.8     | 80.8       | 38.0      | 22.6    |
| 1669     | 39.9  | 5.5        | 1.7       | 8.3     | 82.6       | 39.3      | 22.7    |
| 647      | 47.4  | 4.0        | 1.3       | 74.0    | 19.3       | 37.7      | 22.7    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4589     | 47.6  | 5.4        | 1.8       | 9.1     | 81.9       | 36.1      | 22.7    |
| 474      | 43.6  | 5.7        | 1.9       | 9.6     | 81.0       | 39.5      | 22.7    |
| 374      | 42.0  | 5.0        | 1.6       | 9.9     | 81.2       | 39.9      | 22.7    |
| 4251     | 44.3  | 6.4        | 1.7       | 7.3     | 82.6       | 37.8      | 22.8    |
| 711      | 44.3  | 5.3        | 1.9       | 9.2     | 81.5       | 39.8      | 22.8    |
| 3996     | 44.7  | 5.7        | 1.7       | 9.5     | 81.2       | 35.9      | 22.8    |
| 3387     | 43.5  | 5.2        | 2.0       | 8.1     | 82.7       | 35.9      | 22.9    |
| 3261     | 44.2  | 5.3        | 1.6       | 8.3     | 82.8       | 38.3      | 22.8    |
| 4869     | 41.7  | 5.7        | 1.4       | 9.1     | 82.0       | 40.1      | 22.9    |
| 2972     | 42.4  | 5.6        | 1.9       | 9.2     | 81.5       | 40.3      | 22.9    |
| 4768     | 42.8  | 6.0        | 1.6       | 8.4     | 82.1       | 37.0      | 22.9    |
| 1798     | 43.4  | 5.6        | 2.2       | 9.7     | 80.9       | 37.6      | 22.9    |
| 3461     | 45.6  | 6.0        | 1.7       | 8.2     | 82.1       | 38.2      | 22.9    |
| 1569     | 42.8  | 5.5        | 1.6       | 10.3    | 81.2       | 38.3      | 22.9    |
| 3403     | 46.0  | 5.1        | 2.1       | 8.5     | 82.4       | 40.1      | 22.9    |
| 4501     | 47.8  | 5.0        | 1.6       | 9.9     | 81.6       | 38.2      | 22.9    |
| 550      | 45.9  | 5.0        | 1.8       | 10.3    | 81.6       | 41.1      | 22.9    |
| 1470     | 41.1  | 5.6        | 2.2       | 11.8    | 78.8       | 36.8      | 22.9    |
| 4145     | 42.4  | 5.7        | 2.1       | 9.0     | 81.5       | 37.4      | 22.9    |
| 256      | 42.2  | 5.2        | 1.8       | 10.4    | 80.5       | 40.0      | 22.9    |
| 2447     | 0.0   | 5.1        | 2.4       | 8.6     | 81.6       | 39.4      | 23.0    |
| 4548     | 44.3  | 5.4        | 2.3       | 10.0    | 80.4       | 38.4      | 23.0    |
| 4255     | 42.5  | 5.7        | 1.7       | 9.0     | 81.7       | 38.7      | 23.0    |
| 4542     | 50.9  | 6.4        | 1.8       | 8.1     | 81.8       | 37.7      | 23.0    |
| 4845     | 42.2  | 5.0        | 1.8       | 11.0    | 80.3       | 40.8      | 23.0    |
| 2402     | 42.3  | 4.0        | 1.4       | 72.7    | 20.0       | 39.1      | 23.0    |
| 1788     | 38.4  | 5.6        | 2.6       | 9.2     | 80.7       | 34.7      | 23.0    |
| 4348     | 42.0  | 5.9        | 1.8       | 8.3     | 82.1       | 36.6      | 23.0    |
| 3489     | 31.4  | 6.0        | 2.1       | 9.8     | 80.3       | 33.5      | 23.0    |
| 3656     | 39.8  | 5.1        | 2.4       | 9.2     | 81.4       | 33.5      | 23.1    |
| 917      | 42.0  | 5.6        | 1.6       | 8.7     | 82.2       | 40.8      | 23.1    |
| 4343     | 47.4  | 5.9        | 2.0       | 9.4     | 80.8       | 36.7      | 23.1    |
| 1751     | 42.6  | 5.5        | 1.7       | 8.6     | 82.9       | 39.6      | 23.1    |
| 822      | 44.4  | 5.4        | 1.8       | 8.9     | 82.4       | 40.8      | 23.1    |
| 677      | 47.7  | 5.3        | 1.8       | 9.6     | 82.0       | 39.2      | 23.1    |
| 4764     | 44.7  | 5.3        | 1.9       | 9.9     | 81.0       | 40.2      | 23.1    |
| 4016     | 39.7  | 5.6        | 1.5       | 10.3    | 80.9       | 38.1      | 23.1    |
| 2985     | 47.0  | 4.1        | 1.4       | 76.9    | 15.9       | 40.0      | 23.1    |
| 3793     | 44.5  | 5.7        | 1.7       | 8.6     | 82.1       | 39.2      | 23.1    |
| 3986     | 44.4  | 4.1        | 1.5       | 70.6    | 22.1       | 39.9      | 23.2    |
| 3932     | 50.4  | 3.7        | 1.2       | 79.0    | 15.0       | 38.4      | 23.2    |
| 545      | 44.4  | 4.8        | 1.7       | 10.0    | 82.3       | 42.3      | 23.2    |
| 4788     | 49.9  | 4.1        | 1.7       | 73.6    | 19.0       | 39.5      | 23.2    |
| 2026     | 37.9  | 5.6        | 1.8       | 8.9     | 82.4       | 36.2      | 23.2    |
| 4163     | 42.5  | 4.8        | 2.9       | 9.2     | 81.3       | 41.7      | 23.2    |
| 4726     | 48.3  | 5.7        | 1.8       | 8.5     | 82.0       | 39.5      | 23.2    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 4406     | 44.3  | 5.5        | 1.9       | 9.0     | 81.6       | 39.8      | 23.3    |
| 785      | 46.4  | 5.4        | 2.1       | 9.9     | 80.9       | 39.9      | 23.3    |
| 225      | 39.5  | 5.8        | 2.1       | 8.8     | 81.5       | 38.0      | 23.3    |
| 276      | 47.3  | 4.3        | 1.6       | 68.1    | 24.2       | 36.4      | 23.3    |
| 574      | 43.3  | 5.3        | 1.7       | 9.0     | 82.6       | 39.5      | 23.3    |
| 356      | 40.9  | 4.9        | 1.9       | 8.5     | 82.4       | 39.0      | 23.3    |
| 807      | 44.7  | 4.9        | 2.4       | 8.3     | 82.9       | 34.4      | 23.4    |
| 4809     | 47.7  | 5.3        | 1.5       | 8.9     | 82.4       | 36.0      | 23.4    |
| 4007     | 41.7  | 4.7        | 1.8       | 10.2    | 81.4       | 39.2      | 23.4    |
| 798      | 43.7  | 5.3        | 1.7       | 9.6     | 81.0       | 39.6      | 23.4    |
| 4646     | 46.6  | 5.7        | 2.9       | 9.5     | 80.0       | 38.8      | 23.4    |
| 1666     | 42.0  | 5.2        | 2.1       | 9.6     | 81.4       | 38.0      | 23.4    |
| 2134     | 42.1  | 5.0        | 2.1       | 9.7     | 81.8       | 38.1      | 23.4    |
| 274      | 49.0  | 4.5        | 1.6       | 71.1    | 21.2       | 38.9      | 23.5    |
| 4557     | 46.2  | 6.0        | 2.2       | 10.1    | 79.7       | 37.1      | 23.5    |
| 275      | 49.2  | 4.4        | 1.6       | 70.4    | 22.0       | 37.4      | 23.5    |
| 3277     | 45.8  | 5.8        | 1.7       | 9.7     | 80.7       | 37.3      | 23.5    |
| 4342     | 45.4  | 6.1        | 2.0       | 9.0     | 81.0       | 37.3      | 23.5    |
| 4767     | 43.1  | 6.0        | 1.8       | 8.3     | 81.9       | 36.1      | 23.5    |
| 846      | 43.2  | 5.5        | 1.9       | 8.4     | 82.8       | 37.8      | 23.5    |
| 4164     | 42.4  | 4.8        | 2.9       | 9.4     | 81.2       | 41.5      | 23.6    |
| 3370     | 41.9  | 5.4        | 2.1       | 8.8     | 81.9       | 37.3      | 23.6    |
| 3227     | 45.4  | 6.0        | 2.0       | 7.6     | 82.4       | 40.1      | 23.6    |
| 4643     | 43.7  | 4.7        | 1.9       | 8.4     | 83.2       | 41.3      | 23.6    |
| 562      | 47.4  | 4.8        | 1.8       | 32.2    | 59.7       | 35.7      | 23.6    |
| 3764     | 45.3  | 5.0        | 2.0       | 33.5    | 57.9       | 36.3      | 23.6    |
| 208      | 41.7  | 5.8        | 1.8       | 6.8     | 81.3       | 37.6      | 23.6    |
| 1737     | 42.3  | 5.1        | 1.5       | 39.1    | 52.7       | 37.2      | 23.6    |
| 3186     | 42.2  | 4.6        | 1.7       | 68.5    | 23.6       | 39.0      | 23.7    |
| 4571     | 47.6  | 5.6        | 2.4       | 9.7     | 80.4       | 38.3      | 23.7    |
| 3393     | 40.1  | 5.7        | 1.7       | 9.0     | 81.4       | 36.0      | 23.7    |
| 3252     | 40.5  | 5.5        | 1.6       | 8.3     | 82.6       | 36.6      | 23.7    |
| 783      | 47.1  | 5.7        | 1.8       | 8.9     | 82.1       | 35.8      | 23.7    |
| 1729     | 42.3  | 4.4        | 1.1       | 64.5    | 28.2       | 36.5      | 23.7    |
| 3002     | 45.0  | 5.5        | 1.9       | 7.3     | 83.3       | 36.1      | 23.8    |
| 4394     | 44.4  | 5.1        | 2.5       | 8.5     | 82.0       | 41.2      | 23.8    |
| 4724     | 49.8  | 5.6        | 2.1       | 8.8     | 81.6       | 37.4      | 23.8    |
| 1365     | 47.3  | 4.5        | 1.3       | 67.1    | 25.4       | 37.4      | 23.8    |
| 4618     | 43.8  | 5.9        | 1.8       | 10.4    | 79.9       | 38.9      | 23.8    |
| 4014     | 42.7  | 5.1        | 1.7       | 8.2     | 83.2       | 37.2      | 23.8    |
| 3945     | 37.6  | 4.9        | 1.6       | 61.3    | 30.6       | 35.0 *    | 23.8    |
| 598      | 40.6  | 5.4        | 1.5       | 9.1     | 82.7       | 36.6      | 23.9    |
| 911      | 37.7  | 5.7        | 1.6       | 8.8     | 82.0       | 36.5      | 23.9    |
| 3498     | 43.0  | 5.3        | 2.0       | 7.4     | 83.3       | 38.9      | 23.9    |
| 1191     | 46.4  | 5.9        | 1.7       | 7.7     | 82.8       | 34.3      | 23.9    |
| 237      | 44.8  | 6.1        | 1.6       | 9.0     | 81.5       | 40.3      | 23.9    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 2530     | 29.5  | 5.4        | 2.2       | 7.7     | 82.8       | 36.6 *    | 23.9    |
| 3369     | 1.9   | 5.2        | 2.0       | 8.2     | 82.8       | 37.9      | 23.9    |
| 4334     | 47.7  | 4.9        | 1.8       | 8.0     | 83.5       | 40.1      | 23.9    |
| 3366     | 42.0  | 5.2        | 2.2       | 7.2     | 83.5       | 38.1      | 23.9    |
| 3464     | 40.5  | 6.1        | 1.8       | 7.7     | 82.4       | 36.8      | 23.9    |
| 4732     | 47.3  | 5.5        | 1.9       | 9.7     | 80.9       | 38.9      | 23.9    |
| 449      | 47.7  | 5.0        | 2.3       | 8.3     | 82.9       | 39.0      | 23.9    |
| 4568     | 49.1  | 4.2        | 2.5       | 72.3    | 19.5       | 41.1      | 23.9    |
| 2986     | 44.1  | 4.2        | 1.3       | 75.9    | 16.7       | 37.2      | 23.9    |
| 3385     | 42.7  | 6.1        | 1.7       | 9.3     | 81.0       | 36.7      | 24.0    |
| 3283     | 48.0  | 5.6        | 2.1       | 9.9     | 80.5       | 37.4      | 24.0    |
| 1675     | 40.8  | 5.5        | 1.8       | 9.1     | 81.6       | 35.5      | 24.0    |
| 3543     | 48.8  | 5.1        | 1.8       | 7.9     | 83.2       | 37.5      | 24.0    |
| 1117     | 42.9  | 5.5        | 1.9       | 9.5     | 81.8       | 34.6      | 24.0    |
| 1676     | 42.3  | 5.5        | 1.8       | 9.5     | 81.4       | 36.3      | 24.0    |
| 3083     | 43.5  | 5.5        | 1.9       | 7.8     | 82.7       | 38.5      | 24.0    |
| 921      | 39.6  | 4.7        | 1.6       | 8.6     | 83.4       | 37.8      | 24.0    |
| 1336     | 46.4  | 4.4        | 1.7       | 70.9    | 21.1       | 41.7      | 24.1    |
| 2149     | 39.5  | 5.0        | 2.0       | 9.4     | 82.3       | 39.0      | 24.1    |
| 4402     | 45.9  | 5.9        | 1.7       | 8.9     | 81.4       | 38.1      | 24.1    |
| 73       | 42.1  | 5.6        | 1.6       | 8.5     | 82.4       | 37.3      | 24.1    |
| 2493     | 44.3  | 5.3        | 1.9       | 8.1     | 82.2       | 36.5      | 24.1    |
| 4855     | 41.8  | 4.0        | 1.9       | 69.3    | 22.7       | 39.8      | 24.1    |
| 1649     | 45.8  | 5.6        | 1.5       | 23.8    | 67.6       | 35.7      | 24.1    |
| 3402     | 44.9  | 5.1        | 2.3       | 8.9     | 81.7       | 38.9      | 24.1    |
| 235      | 39.2  | 5.6        | 2.9       | 9.3     | 80.4       | 37.7      | 24.1    |
| 3846     | 41.7  | 4.8        | 2.5       | 8.5     | 82.1       | 40.6      | 24.1    |
| 258      | 40.5  | 5.2        | 1.7       | 10.3    | 80.9       | 39.2      | 24.1    |
| 3410     | 42.5  | 5.0        | 1.7       | 8.6     | 83.0       | 37.6      | 24.1    |



HIGH OIL  
HIGH OLEIC  
LINES



| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 212      | 47.0  | 3.6        | 1.3       | 80.8    | 12.4       | 38.9      | 19.1    |
| 211      | 46.1  | 3.5        | 1.2       | 79.5    | 13.9       | 40.1      | 18.6    |
| 3932     | 50.4  | 3.7        | 1.2       | 79.0    | 15.0       | 38.4      | 23.2    |
| 4547     | 44.8  | 3.6        | 1.2       | 78.4    | 14.9       | 29.2      | 31.0    |
| 4875     | 47.8  | 3.5        | 1.4       | 78.3    | 15.3       | 34.8      | 27.9    |
| 1332     | 46.5  | 3.9        | 1.4       | 78.2    | 14.7       | 36.9      | 27.6    |
| 3342     | 45.3  | 3.5        | 1.6       | 77.7    | 15.5       | 28.8      | 35.6    |
| 2246     | 46.5  | 3.9        | 1.4       | 77.4    | 15.6       | 34.3      | 26.6    |
| 2985     | 47.0  | 4.1        | 1.4       | 76.9    | 15.9       | 40.0      | 23.1    |
| 3930     | 50.2  | 3.9        | 1.3       | 76.4    | 16.9       | 40.8      | 18.9    |
| 2247     | 45.5  | 3.9        | 1.3       | 76.3    | 16.8       | 33.6      | 28.1    |
| 3010     | 47.9  | 3.9        | 1.7       | 76.2    | 16.6       | 35.0      | 33.7    |
| 3016     | 45.1  | 4.2        | 1.8       | 76.2    | 16.2       | 37.7      | 25.9    |
| 3052     | 45.2  | 4.0        | 1.5       | 75.9    | 17.0       | 28.0      | 35.9    |
| 3014     | 46.2  | 4.1        | 1.7       | 75.9    | 16.8       | 35.6      | 28.8    |
| 1409     | 44.8  | 4.2        | 1.5       | 75.5    | 17.3       | 41.7      | 15.7    |
| 3931     | 48.8  | 4.2        | 1.4       | 75.5    | 17.4       | 41.7      | 20.2    |
| 3011     | 45.9  | 4.0        | 1.7       | 75.2    | 17.5       | 30.3      | 34.5    |
| 4752     | 45.1  | 4.1        | 1.5       | 75.2    | 17.6       | 24.2      | 40.2    |
| 471      | 46.1  | 4.1        | 1.5       | 74.7    | 18.2       | 40.1      | 22.5    |
| 2984     | 48.3  | 4.3        | 1.5       | 74.6    | 18.0       | 35.4      | 28.1    |
| 3015     | 45.3  | 4.2        | 1.9       | 74.6    | 17.7       | 37.3      | 25.1    |
| 1327     | 48.8  | 4.2        | 1.3       | 74.2    | 18.6       | 36.8      | 27.1    |
| 4148     | 48.2  | 4.4        | 1.3       | 74.1    | 18.5       | 37.3      | 25.5    |
| 470      | 45.3  | 4.0        | 1.4       | 74.0    | 18.9       | 39.5      | 25.4    |
| 647      | 47.4  | 4.0        | 1.3       | 74.0    | 19.3       | 37.7      | 22.7    |
| 2962     | 44.8  | 3.7        | 1.3       | 74.0    | 19.5       | 31.2      | 30.2    |
| 4549     | 44.9  | 4.4        | 1.4       | 74.0    | 18.8       | 26.2      | 36.0    |
| 4355     | 46.7  | 4.3        | 1.4       | 73.7    | 19.1       | 28.9      | 32.0    |
| 2976     | 45.5  | 3.9        | 1.5       | 73.7    | 19.3       | 34.3      | 30.4    |
| 3013     | 45.6  | 4.4        | 1.8       | 73.6    | 18.7       | 33.4      | 34.5    |
| 4788     | 49.9  | 4.1        | 1.7       | 73.6    | 19.0       | 39.5      | 23.2    |
| 4453     | 45.4  | 3.7        | 1.5       | 73.6    | 19.7       | 29.1      | 36.6    |
| 4152     | 45.0  | 4.3        | 1.3       | 73.5    | 19.2       | 36.0      | 31.0    |
| 3988     | 45.4  | 4.2        | 1.6       | 73.5    | 18.9       | 36.7      | 25.9    |
| 4614     | 45.8  | 4.0        | 1.7       | 73.5    | 19.2       | 33.3      | 31.0    |
| 4151     | 46.1  | 4.3        | 1.3       | 73.2    | 19.6       | 35.3      | 27.9    |
| 1333     | 48.5  | 4.2        | 1.3       | 73.2    | 19.5       | 37.1      | 29.9    |
| 4615     | 44.8  | 4.2        | 1.7       | 73.1    | 19.5       | 31.7      | 31.4    |
| 1734     | 45.1  | 4.4        | 1.4       | 72.9    | 19.6       | 34.2      | 27.4    |
| 4789     | 50.2  | 4.1        | 1.7       | 72.8    | 19.6       | 39.0      | 21.2    |
| 1632     | 47.6  | 4.7        | 1.4       | 72.7    | 19.6       | 27.9      | 31.1    |
| 1604     | 48.6  | 3.8        | 1.4       | 72.5    | 20.7       | 36.8      | 22.2    |
| 1637     | 46.9  | 4.4        | 1.2       | 72.5    | 20.3       | 31.0      | 28.3    |
| 4153     | 46.3  | 4.3        | 1.3       | 72.5    | 20.4       | 38.4      | 26.9    |
| 1625     | 46.3  | 4.6        | 1.4       | 72.3    | 20.2       | 26.6      | 33.4    |
| 4568     | 49.1  | 4.2        | 2.5       | 72.3    | 19.5       | 41.1      | 23.9    |
| 2175     | 46.0  | 4.0        | 1.2       | 72.2    | 21.1       | 25.0      | 33.3    |

| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 1628     | 45.4  | 4.3        | 1.4       | 72.2    | 20.5       | 29.6      | 30.4    |
| 4149     | 47.0  | 4.4        | 1.3       | 72.2    | 20.6       | 34.5      | 28.7    |
| 4670     | 45.0  | 4.2        | 1.3       | 71.9    | 21.0       | 27.7      | 38.0    |
| 273      | 48.7  | 4.5        | 1.7       | 71.5    | 20.6       | 38.2      | 21.8    |
| 2174     | 45.0  | 4.1        | 1.2       | 71.5    | 21.6       | 25.5      | 36.8    |
| 3933     | 47.4  | 3.7        | 1.5       | 71.4    | 21.8       | 38.2      | 26.0    |
| 1396     | 46.8  | 4.4        | 1.4       | 71.3    | 21.3       | 29.2      | 32.3    |
| 2177     | 46.1  | 4.0        | 1.3       | 71.2    | 21.9       | 26.6      | 33.0    |
| 4611     | 46.0  | 4.4        | 1.4       | 71.1    | 21.8       | 34.2      | 30.4    |
| 274      | 49.0  | 4.5        | 1.6       | 71.1    | 21.2       | 38.9      | 23.5    |
| 466      | 47.5  | 4.6        | 1.5       | 71.0    | 21.5       | 37.7      | 24.2    |
| 1336     | 46.4  | 4.4        | 1.7       | 70.9    | 21.1       | 41.7      | 24.1    |
| 4853     | 47.3  | 4.6        | 1.5       | 70.8    | 21.3       | 33.9      | 27.7    |
| 856      | 44.8  | 4.0        | 1.1       | 70.5    | 22.9       | 41.5      | 20.1    |
| 275      | 49.2  | 4.4        | 1.6       | 70.4    | 22.0       | 37.4      | 23.5    |
| 2906     | 45.5  | 4.0        | 1.5       | 70.3    | 22.6       | 28.6      | 35.2    |
| 2173     | 46.2  | 4.1        | 1.2       | 69.9    | 23.2       | 27.8      | 33.7    |
| 4422     | 45.0  | 4.2        | 1.5       | 69.8    | 23.0       | 32.2      | 36.0    |
| 1387     | 45.3  | 4.6        |           | 69.5    | 23.9       | 29.2      | 32.6    |
| 4673     | 45.5  | 4.3        | 1.4       | 69.5    | 23.2       | 28.6      | 35.1    |
| 3427     | 45.8  | 4.0        | 1.3       | 69.5    | 23.5       | 34.8      | 28.1    |
| 2117     | 47.2  | 4.4        | 1.8       | 69.4    | 22.7       | 36.7      | 22.0    |
| 2171     | 45.1  | 4.1        | 1.2       | 69.4    | 23.9       | 24.9      | 36.4    |
| 3982     | 44.8  | 4.2        | 1.7       | 68.9    | 23.5       | 37.6      | 21.7    |
| 4852     | 48.4  | 4.4        | 1.4       | 68.9    | 23.5       | 32.8      | 30.1    |
| 2170     | 45.3  | 4.2        | 1.3       | 68.9    | 24.2       | 27.0      | 34.5    |
| 4841     | 45.5  | 4.2        | 1.3       | 68.7    | 24.2       | 23.4      | 39.3    |
| 1037     | 45.7  | 5.6        | 1.5       | 68.5    | 23.7       | 27.9      | 35.6    |
| 1392     | 45.3  | 4.5        | 1.5       | 68.3    | 24.0       | 31.4      | 31.8    |
| 276      | 47.3  | 4.3        | 1.6       | 68.1    | 24.2       | 36.4      | 23.3    |
| 2176     | 45.5  | 4.1        | 1.3       | 67.9    | 25.0       | 25.8      | 35.8    |
| 4844     | 45.9  | 4.6        | 1.3       | 67.3    | 25.3       | 33.8      | 25.2    |
| 2172     | 46.6  | 4.2        | 1.3       | 67.2    | 25.9       | 28.1      | 32.5    |
| 1365     | 47.3  | 4.5        | 1.3       | 67.1    | 25.4       | 37.4      | 23.8    |
| 1646     | 48.7  | 4.7        | 1.3       | 66.7    | 25.9       | 37.7      | 18.4    |
| 1393     | 48.6  | 4.6        | 1.4       | 66.3    | 26.1       | 30.0      | 32.4    |
| 1401     | 47.8  | 4.7        | 1.4       | 65.7    | 26.5       | 31.3      | 25.6    |
| 4581     | 45.9  | 4.5        | 1.5       | 65.2    | 27.1       | 35.0      | 28.0    |
| 1311     | 45.9  | 4.3        | 1.4       | 64.4    | 28.3       |           |         |
| 1389     | 45.4  | 4.7        | 1.5       | 55.8    | 36.4       | 29.1      | 33.7    |
| 4066     | 47.2  | 5.0        | 1.7       | 45.4    | 46.2       | 31.3      | 27.9    |
| 1408     | 45.5  | 4.8        | 1.8       | 42.8    | 49.0       | 39.6      | 19.3    |
| 1118     | 49.9  | 4.7        | 1.7       | 39.2    | 53.0       | 34.5      | 21.8    |
| 4330     | 46.3  | 4.4        | 1.5       | 37.5    | 55.4       | 40.7      | 26.9    |
| 3697     | 45.5  | 5.8        | 1.8       | 37.4    | 53.6       | 27.8      | 32.7    |
| 1328     | 47.3  | 5.0        | 1.5       | 35.7    | 53.1       | 33.1      | 32.5    |
| 3764     | 45.3  | 5.0        | 2.0       | 33.5    | 57.9       | 36.3      | 23.6    |

HIGH PROTEIN  
HIGH OLEIC  
LINES



| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 212      | 47.0  | 3.6        | 1.3       | 80.8    | 12.4       | 38.9      | 19.1    |
| 211      | 46.1  | 3.5        | 1.2       | 79.5    | 13.9       | 40.1      | 18.6    |
| 3932     | 50.4  | 3.7        | 1.2       | 79.0    | 15.0       | 38.4      | 23.2    |
| 2985     | 47.0  | 4.1        | 1.4       | 76.9    | 15.9       | 40.0      | 23.1    |
| 3930     | 50.2  | 3.9        | 1.3       | 76.4    | 16.9       | 40.8      | 18.9    |
| 863      | 35.7  | 4.1        | 1.2       | 76.2    | 16.9       | 38.4      | 21.4    |
| 2986     | 44.1  | 4.2        | 1.3       | 75.9    | 16.7       | 37.2      | 23.9    |
| 1409     | 44.8  | 4.2        | 1.5       | 75.5    | 17.3       | 41.7      | 15.7    |
| 3931     | 48.8  | 4.2        | 1.4       | 75.5    | 17.4       | 41.7      | 20.2    |
| 471      | 46.1  | 4.1        | 1.5       | 74.7    | 18.2       | 40.1      | 22.5    |
| 647      | 47.4  | 4.0        | 1.3       | 74.0    | 19.3       | 37.7      | 22.7    |
| 4788     | 49.9  | 4.1        | 1.7       | 73.6    | 19.0       | 39.5      | 23.2    |
| 869      | 42.8  | 3.8        | 1.3       | 73.5    | 19.8       | 42.7      | 18.8    |
| 4789     | 50.2  | 4.1        | 1.7       | 72.8    | 19.6       | 39.0      | 21.2    |
| 2402     | 42.3  | 4.0        | 1.4       | 72.7    | 20.0       | 39.1      | 23.0    |
| 1604     | 48.6  | 3.8        | 1.4       | 72.5    | 20.7       | 36.8      | 22.2    |
| 210      | 40.3  | 4.1        | 1.3       | 72.5    | 20.4       | 40.8      | 18.0    |
| 2403     | 40.8  | 4.0        | 1.5       | 72.4    | 20.3       | 41.3      | 20.1    |
| 4568     | 49.1  | 4.2        | 2.5       | 72.3    | 19.5       | 41.1      | 23.9    |
| 273      | 48.7  | 4.5        | 1.7       | 71.5    | 20.6       | 38.2      | 21.8    |
| 274      | 49.0  | 4.5        | 1.6       | 71.1    | 21.2       | 38.9      | 23.5    |
| 1336     | 46.4  | 4.4        | 1.7       | 70.9    | 21.1       | 41.7      | 24.1    |
| 3986     | 44.4  | 4.1        | 1.5       | 70.6    | 22.1       | 39.9      | 23.2    |
| 856      | 44.8  | 4.0        | 1.1       | 70.5    | 22.9       | 41.5      | 20.1    |
| 275      | 49.2  | 4.4        | 1.6       | 70.4    | 22.0       | 37.4      | 23.5    |
| 1541     | 43.9  | 4.1        | 1.0       | 69.7    | 23.6       | 39.3      | 19.7    |
| 2117     | 47.2  | 4.4        | 1.8       | 69.4    | 22.7       | 36.7      | 22.0    |
| 4855     | 41.8  | 4.0        | 1.9       | 69.3    | 22.7       | 37.8      | 24.1    |
| 4822     | 44.6  | 4.4        | 1.5       | 69.0    | 23.7       | 40.8      | 21.6    |
| 3982     | 44.8  | 4.2        | 1.7       | 68.9    | 23.5       | 37.6      | 21.7    |
| 3186     | 42.2  | 4.6        | 1.7       | 68.5    | 23.6       | 39.0      | 23.7    |
| 4277     | 43.1  | 4.1        | 1.4       | 68.2    | 24.8       | 36.3      | 22.5    |
| 276      | 47.3  | 4.3        | 1.6       | 68.1    | 24.2       | 36.4      | 23.3    |
| 1365     | 47.3  | 4.5        | 1.3       | 67.1    | 25.4       | 37.4      | 23.8    |
| 1646     | 48.7  | 4.7        | 1.3       | 66.7    | 25.9       | 37.7      | 18.4    |
| 1729     | 42.3  | 4.4        | 1.1       | 64.5    | 28.2       | 36.5      | 23.7    |
| 3945     | 37.6  | 4.9        | 1.6       | 61.3    | 30.6       | 35.0      | 23.3    |
| 3670     | 37.9  | 4.9        | 1.6       | 57.2    | 34.8       | 40.4      | 15.3    |
| 1408     | 45.5  | 4.8        | 1.8       | 42.8    | 49.0       | 39.6      | 19.3    |
| 1118     | 49.9  | 4.7        | 1.7       | 39.2    | 53.0       | 34.5      | 21.8    |
| 1737     | 42.3  | 5.1        | 1.5       | 39.1    | 52.7       | 37.2      | 23.6    |
| 3764     | 45.3  | 5.0        | 2.0       | 33.5    | 57.9       | 36.3      | 23.6    |
| 1602     | 47.3  | 5.1        | 1.6       | 33.4    | 58.6       | 36.0      | 20.7    |
| 749      | 43.4  | 4.8        | 1.7       | 33.1    | 58.9       | 38.1      | 21.3    |
| 1636     | 46.0  | 5.4        | 1.4       | 32.3    | 59.5       | 34.8      | 20.1    |
| 562      | 47.4  | 4.8        | 1.8       | 32.2    | 59.7       | 35.7      | 23.6    |
| 4622     | 49.2  | 5.8        | 2.0       | 26.1    | 64.6       | 37.5      | 21.6    |
| 1649     | 45.8  | 5.6        | 1.5       | 23.8    | 67.6       | 35.7      | 24.1    |



LOW FIBER  
HIGH OLEIC  
LINES



| SAMPLE # | % OIL | % PALMITIC | % STEARIC | % OLEIC | % LINOLEIC | % PROTEIN | % FIBER |
|----------|-------|------------|-----------|---------|------------|-----------|---------|
|          | NMR   | C-16:0     | C-18:0    | C-18:1  | C-18:2     | NIR       | NIR     |
| 212      | 47.0  | 3.6        | 1.3       | 80.8    | 12.4       | 38.9      | 19.1    |
| 211      | 46.1  | 3.5        | 1.2       | 79.5    | 13.9       | 40.1      | 18.6    |
| 3932     | 50.4  | 3.7        | 1.2       | 79.0    | 15.0       | 38.4      | 23.2    |
| 2985     | 47.0  | 4.1        | 1.4       | 76.9    | 15.9       | 40.0      | 23.1    |
| 3930     | 50.2  | 3.9        | 1.3       | 76.4    | 16.9       | 40.8      | 18.9    |
| 863      | 35.7  | 4.1        | 1.2       | 76.2    | 16.9       | 38.4      | 21.4    |
| 1409     | 44.8  | 4.2        | 1.5       | 75.5    | 17.3       | 41.7      | 15.7    |
| 3931     | 48.8  | 4.2        | 1.4       | 75.5    | 17.4       | 41.7      | 20.2    |
| 2398     | 40.7  | 3.7        | 1.4       | 75.1    | 18.0       | 38.3      | 24.3    |
| 471      | 46.1  | 4.1        | 1.5       | 74.7    | 18.2       | 40.1      | 22.5    |
| 470      | 45.3  | 4.0        | 1.4       | 74.0    | 18.9       | 39.5      | 25.4    |
| 4788     | 49.9  | 4.1        | 1.7       | 73.6    | 19.0       | 39.5      | 23.2    |
| 869      | 42.8  | 3.8        | 1.3       | 73.5    | 19.8       | 42.7      | 18.8    |
| 4789     | 50.2  | 4.1        | 1.7       | 72.8    | 19.6       | 39.0      | 21.2    |
| 2402     | 42.3  | 4.0        | 1.4       | 72.7    | 20.0       | 39.1      | 23.0    |
| 210      | 40.3  | 4.1        | 1.3       | 72.5    | 20.4       | 40.8      | 18.0    |
| 4153     | 46.3  | 4.3        | 1.3       | 72.5    | 20.4       | 38.4      | 26.9    |
| 2403     | 40.8  | 4.0        | 1.5       | 72.4    | 20.3       | 41.3      | 20.1    |
| 4568     | 49.1  | 4.2        | 2.5       | 72.3    | 19.5       | 41.1      | 23.9    |
| 273      | 48.7  | 4.5        | 1.7       | 71.5    | 20.6       | 38.2      | 21.8    |
| 3933     | 47.4  | 3.7        | 1.5       | 71.4    | 21.8       | 38.2      | 26.0    |
| 274      | 49.0  | 4.5        | 1.6       | 71.1    | 21.2       | 38.9      | 23.5    |
| 1336     | 46.4  | 4.4        | 1.7       | 70.9    | 21.1       | 41.7      | 24.1    |
| 3986     | 44.4  | 4.1        | 1.5       | 70.6    | 22.1       | 39.9      | 23.2    |
| 856      | 44.8  | 4.0        | 1.1       | 70.5    | 22.9       | 41.5      | 20.1    |
| 1541     | 43.9  | 4.1        | 1.0       | 69.7    | 23.6       | 39.3      | 19.7    |
| 4855     | 41.8  | 4.0        | 1.9       | 69.3    | 22.7       | 39.8      | 24.1    |
| 4822     | 44.6  | 4.4        | 1.5       | 69.0    | 23.7       | 40.8      | 21.6    |
| 4857     | 37.7  | 4.1        | 1.9       | 68.9    | 23.0       | 39.1      | 25.5    |
| 3186     | 42.2  | 4.6        | 1.7       | 68.5    | 23.6       | 39.0      | 23.7    |
| 3670     | 37.9  | 4.9        | 1.6       | 57.2    | 34.8       | 40.4      | 15.3    |
| 1408     | 45.5  | 4.8        | 1.8       | 42.8    | 49.0       | 39.6      | 19.3    |
| 2404     | 42.7  | 4.6        | 1.5       | 42.0    | 50.0       | 28.2      | 24.4    |
| 4330     | 46.3  | 4.4        | 1.5       | 37.5    | 55.4       | 40.7      | 26.9    |
| 749      | 43.4  | 4.8        | 1.7       | 33.1    | 58.9       | 39.1      | 21.3    |
| 4622     | 49.2  | 5.8        | 2.0       | 26.1    | 64.6       | 39.5      | 21.6    |
| 3378     | 39.2  | 5.2        | 1.8       | 15.8    | 75.2       | 38.4      | 21.6    |



**LOW OIL COLOR  
HIGH OLEIC  
LINES**



| SAMPLE # | % OIL | % C-16:0 | % C-18:0 | % C-18:1 | % C-18:2 | % PROTEIN | % FIBER | OIL COLOR RATING |
|----------|-------|----------|----------|----------|----------|-----------|---------|------------------|
| 2031     | 38.5  | 3.8      | 1.5      | 76.0     | 16.9     | 27.6      | 32.7    | 0.5              |
| 4811     | 39.3  | 4.0      | 1.7      | 75.7     | 16.7     | 22.8      | 44.1    | 0.5              |
| 3183     | 41.4  | 4.1      | 1.6      | 75.7     | 17.0     | 23.8      | 37.4    | 0.5              |
| 2033     | 37.8  | 3.9      | 1.5      | 75.5     | 17.4     | 25.8      | 35.3    | 0.5              |
| 2988     | 39.0  | 4.1      | 1.9      | 75.4     | 16.8     | 30.0      | 36.3    | 0.5              |
| 2091     | 39.8  | 4.5      | 1.3      | 75.1     | 17.2     | 24.7      | 35.4    | 0.5              |
| 3184     | 41.0  | 4.2      | 1.7      | 74.8     | 17.7     | 24.0      | 38.6    | 0.5              |
| 2243     | 44.2  | 3.9      | 1.4      | 74.7     | 18.3     | 27.0      | 34.3    | 0.5              |
| 3332     | 40.7  | 3.9      | 1.2      | 74.5     | 19.0     | 25.3      | 35.4    | 0.5              |
| 3335     | 40.3  | 3.9      | 1.3      | 74.3     | 19.1     | 26.0      | 34.1    | 0.5              |
| 3334     | 41.4  | 3.8      | 1.3      | 74.3     | 19.1     | 27.7      | 34.8    | 0.5              |
| 2431     | 40.6  | 4.4      | 1.3      | 74.1     | 18.5     | 23.6      | 37.6    | 0.5              |
| 2044     | 38.7  | 3.8      | 1.6      | 74.1     | 18.6     | 27.2      | 37.0    | 0.5              |
| 2029     | 38.3  | 3.9      | 1.6      | 73.9     | 18.8     | 24.9      | 36.0    | 0.5              |
| 3333     | 41.3  | 3.9      | 1.3      | 73.9     | 19.5     | 28.2      | 35.2    | 0.5              |
| 2032     | 36.8  | 3.8      | 1.7      | 73.8     | 18.7     | 26.1      | 36.1    | 0.5              |
| 2030     | 37.9  | 3.8      | 1.6      | 73.5     | 19.3     | 26.5      | 34.0    | 0.5              |
| 2043     | 36.8  | 3.8      | 1.7      | 73.4     | 19.3     | 28.4      | 36.5    | 0.5              |
| 4556     | 41.2  | 4.1      | 1.2      | 73.3     | 19.9     | 25.8      | 35.5    | 0.5              |
| 3331     | 41.0  | 3.9      | 1.3      | 73.3     | 20.0     | 26.0      | 34.7    | 0.5              |
| 2990     | 40.9  | 3.9      | 2.0      | 73.3     | 19.2     | 28.1      | 38.0    | 0.5              |
| 2975     | 40.4  | 3.9      | 1.5      | 72.9     | 20.0     | 29.6      | 34.2    | 0.5              |
| 4483     | 42.2  | 4.2      | 1.7      | 72.7     | 20.0     | 28.7      | 35.2    | 0.5              |
| 2989     | 41.1  | 4.1      | 1.8      | 72.5     | 19.8     | 31.5      | 34.1    | 0.5              |
| 2936     | 29.8  | 4.4      | 1.6      | 72.5     | 19.8     | 23.0      | 39.6    | 0.5              |
| 2945     | 41.3  | 4.1      | 1.4      | 72.4     | 20.5     | 23.4      | 38.2    | 0.5              |
| 3330     | 40.9  | 3.9      | 1.3      | 72.4     | 21.0     | 28.1      | 33.9    | 0.5              |
| 4546     | 40.9  | 3.8      | 1.3      | 72.1     | 21.1     | 29.9      | 37.6    | 0.5              |
| 4101     | 44.3  | 4.0      | 1.4      | 72.1     | 21.0     | 33.0      | 30.3    | 0.5              |
| 4812     | 42.1  | 4.0      | 1.6      | 72.0     | 20.8     | 24.5      | 42.2    | 0.5              |
| 4102     | 36.3  | 3.9      | 1.3      | 71.6     | 21.5     | 26.4      | 38.7    | 0.5              |
| 2991     | 38.2  | 4.2      | 1.6      | 71.2     | 21.4     | 26.3      | 40.2    | 0.5              |
| 1769     | 38.6  | 4.3      | 1.4      | 71.2     | 21.8     | 25.8      | 35.3    | 0.5              |
| 2427     | 40.7  | 4.3      | 1.4      | 70.5     | 22.3     | 24.0      | 38.6    | 0.5              |
| 2934     | 31.4  | 4.2      | 1.4      | 69.7     | 23.2     | 20.9      | 40.9    | 0.5              |
| 4555     | 41.1  | 4.1      | 1.3      | 69.5     | 23.7     | 29.0      | 35.7    | 0.5              |
| 4025     | 41.5  | 3.8      | 1.3      | 68.6     | 24.7     |           |         | 0.5 *            |
| 4631     | 40.7  | 4.5      | 1.5      | 68.5     | 23.8     | 24.1      | 43.1    | 0.5              |
| 2931     | 35.6  | 4.0      | 1.1      | 68.4     | 25.1     | 29.0      | 32.6    | 0.5              |
| 3953     | 38.3  | 4.6      | 1.6      | 68.4     | 23.8     | 26.0      | 40.8    | 0.5              |
| 4721     | 38.9  | 4.2      | 1.7      | 68.2     | 24.3     | 25.5      | 41.8    | 0.5              |
| 3569     | 42.3  | 4.4      | 1.8      | 67.3     | 24.9     | 30.0      | 36.5    | 0.5              |
| 4774     | 40.9  | 3.9      | 1.3      | 66.3     | 27.1     | 28.1      | 34.6    | 0.5              |
| 2004     | 37.5  | 4.8      | 1.7      | 65.8     | 26.3     | 23.8      | 39.3    | 0.5              |
| 1987     | 37.6  | 4.8      | 1.6      | 65.6     | 26.3     | 24.8      | 25.0    | 0.5              |
| 2006     | 36.9  | 4.9      | 1.7      | 65.4     | 26.5     | 22.7      | 37.9    | 0.5              |
| 3951     | 37.8  | 4.9      | 1.6      | 65.1     | 23.8     | 22.2      | 39.8    | 0.5              |
| 4865     | 40.3  | 4.6      | 1.7      | 65.0     | 27.5     | 27.6      | 39.4    | 0.5              |
| 2009     | 38.8  | 4.9      | 1.6      | 64.9     | 27.2     | 23.6      | 37.3    | 0.5              |
| 3568     | 39.1  | 4.4      | 1.8      | 64.7     | 27.6     | 26.7      | 40.9    | 0.5              |

| SAMPLE # | % OIL | % C-16:0 | % C-18:0 | % C-18:1 | % C-18:2 | % PROTEIN | % FIBER | OIL COLOR RATING |
|----------|-------|----------|----------|----------|----------|-----------|---------|------------------|
| 3270     | 31.9  | 4.2      | 1.8      | 64.4     | 27.9     | 28.9      | 35.8    | 0.5              |
| 1996     | 38.0  | 4.8      | 1.6      | 64.2     | 27.9     | 23.3      | 38.5    | 0.5              |
| 3763     | 36.0  | 4.3      | 1.4      | 64.2     | 28.7     | 27.0      | 33.2    | 0.5              |
| 2005     | 37.2  | 4.9      | 1.7      | 63.6     | 28.4     | 24.1      | 39.8    | 0.5              |
| 2008     | 37.1  | 4.9      | 1.6      | 62.7     | 29.3     | 24.2      | 27.4    | 0.5              |
| 3623     | 41.6  | 4.7      | 1.7      | 62.1     | 30.1     | 28.6      | 38.7    | 0.5              |
| 3952     | 37.4  | 5.0      | 1.6      | 62.0     | 29.9     | 19.4      | 39.4    | 0.5              |
| 3624     | 41.5  | 4.9      | 1.7      | 59.7     | 32.4     | 29.5      | 37.5    | 0.5              |
| 3669     | 41.0  | 4.8      | 1.7      | 59.7     | 32.5     | 22.4      | 38.8    | 0.5              |
| 4814     | 40.4  | 4.7      | 1.3      | 57.1     | 35.4     | 33.6      | 31.7    | 0.5              |
| 4757     | 31.8  | 5.2      | 1.6      | 53.5     | 38.2     | 20.3      | 41.1    | 0.5              |
| 2937     | 32.6  | 4.7      | 1.6      | 48.2     | 44.2     | 22.1      | 38.0    | 0.5              |
| 3638     | 41.4  | 4.6      | 1.7      | 48.0     | 44.5     |           |         | 0.5              |
| 3762     | 31.8  | 4.8      | 1.5      | 47.2     | 45.3     | 27.6      | 31.0    | 0.5 *            |
| 3865     | 35.2  | 4.5      | 1.7      | 34.2     | 58.1     | 24.0      | 44.4    | 0.5              |

TOP OLEIC ACID  
PROGENY FROM  
1985 LINES



| SAMPLE<br># | %<br>PALMITIC | %<br>STEARIC | %<br>OLEIC | %<br>LINOLEIC |
|-------------|---------------|--------------|------------|---------------|
|             | 16:0          | 18:0         | 18:1       | 18:2          |
| 5b4102-1    | 3.5           | 1.4          | 84.7       | 8.6           |
| 5b4546-3    | 3.1           | 1.8          | 84.6       | 8.4           |
| 5b4546-5    | 3.3           | 1.3          | 84.3       | 9.0           |
| 85b2958-1   | 3.2           | 1.3          | 84.3       | 9.3           |
| 5b4101-4    | 3.3           | 1.0          | 84.1       | 10.0          |
| 6b3242-2    | 3.5           | 1.4          | 84.0       | 9.6           |
| 85b2958-2   | 2.9           | 1.6          | 83.9       | 9.8           |
| 6b3492-3    | 3.4           | 1.6          | 83.8       | 10.8          |
| 86b3243-2   | 3.5           | 1.4          | 83.8       | 11.1          |
| 6b2923-5    | 3.0           | 1.1          | 83.8       | 10.2          |
| 86b2924-3   | 3.3           | 1.1          | 83.7       | 10.2          |
| 86b2928-1   | 3.2           | 1.1          | 83.6       | 10.5          |
| 6b2924-3    | 3.2           | 1.2          | 83.6       | 10.0          |
| 5b4546-1    | 3.3           | 1.5          | 83.5       | 9.8           |
| 5b4002-5    | 3.3           | 1.7          | 83.4       | 9.8           |
| 6b2927-1    | 3.2           | 1.3          | 83.3       | 10.2          |
| 6b4509-1    | 3.7           | 1.4          | 83.3       | 10.0          |
| 6b2922-2    | 3.2           | 1.0          | 83.1       | 11.1          |
| 6b4509-2    | 3.4           | 1.9          | 83.1       | 10.0          |
| 6b2923-4    | 3.0           | 1.1          | 83.0       | 10.9          |
| 5b1332-1    | 3.3           | 1.6          | 83.0       | 10.4          |
| 6b4511-4    | 3.2           | 1.8          | 83.0       | 10.4          |
| 86b2928-3   | 3.4           | 1.4          | 83.0       | 10.5          |
| 6b2922-1    | 3.1           | 1.3          | 83.0       | 11.0          |
| 6b2927-2    | 3.1           | 0.8          | 82.9       | 11.4          |
| 6b2925-3    | 3.7           | 1.3          | 82.9       | 10.4          |
| 6b4510-3    | 3.5           | 1.7          | 82.8       | 10.2          |
| 5b4546-2    | 3.3           | 1.1          | 82.8       | 10.5          |
| 6b4978-2    | 3.3           | 2.1          | 82.8       | 10.1          |
| 6b4509-5    | 3.3           | 1.7          | 82.8       | 10.7          |
| 6b2927-3    | 3.2           | 1.0          | 82.7       | 11.3          |
| 6b5607-3    | 3.4           | 1.4          | 82.7       | 10.6          |
| 6b4509-3    | 3.4           | 1.9          | 82.7       | 10.3          |
| 6b2924-4    | 3.2           | 1.2          | 82.6       | 11.2          |
| 5b4102-2    | 3.3           | 1.2          | 82.6       | 11.2          |
| 86b3243-3   | 3.2           | 1.3          | 82.6       | 11.6          |
| 86b2926-5   | 3.4           | 1.2          | 82.5       | 11.2          |
| 5b2092-3    | 4.2           | 1.5          | 82.5       | 10.0          |
| 6b4967-4    | 3.6           | 2.0          | 82.5       | 10.0          |
| 6b4327-5    | 3.0           | 1.4          | 82.5       | 11.5          |
| 6b2925-2    | 3.9           | 0.9          | 82.4       | 10.5          |
| 5b2036-1    | 3.2           | 1.1          | 82.4       | 11.8          |
| 5b4752-2    | 3.7           | .2*          | 82.4       | 11.3          |
| 86b4508-4   | 4.0           | 1.9          | 82.3       | 10.2          |
| 6b2922-3    | 4.0           | 1.3          | 82.3       | 10.7          |
| 86b2926-3   | 3.6           | 1.3          | 82.3       | 11.0          |
| 5b4752-1    | 4.0           | .3*          | 82.2       | 11.4          |

| SAMPLE<br># | %<br>PALMITIC | %<br>STEARIC | %<br>OLEIC | %<br>LINOLEIC |
|-------------|---------------|--------------|------------|---------------|
|             | 16:0          | 18:0         | 18:1       | 18:2          |
| 5b3987-4    | 3.9           | 1.8          | 82.2       | 10.2          |
| 86b4508-2   | 3.9           | 2.0          | 82.2       | 10.5          |
| 5b2951-1    | 4.7           | 1.4          | 82.2       | 10.4          |
| 5b2035-5    | 2.5           | 1.0          | 82.2       | 12.8          |
| 5b2203-4    | 3.6           | 1.6          | 82.2       | 10.5          |
| 6b3066-2    | 3.5           | 1.7          | 82.2       | 10.8          |
| 5b3750-4    | 3.5           | 2.0          | 82.1       | 10.6          |
| 6b4507-2    | 4.1           | 1.4          | 82.0       | 11.0          |
| 5b2092-4    | 4.1           | 1.3          | 82.0       | 10.9          |
| 5b757-2     | 3.6           | 1.7          | 82.0       | 11.2          |
| 6b3066-4    | 3.7           | 1.8          | 82.0       | 10.8          |
| 6b4362-4    | 3.9           | 1.8          | 81.9       | 10.6          |
| 86b4508-3   | 3.6           | 2.1          | 81.9       | 10.5          |
| 5b332-3     | 3.3           | 1.3          | 81.8       | 13.5          |
| 6b2923-1    | 3.4           | 1.0          | 81.8       | 11.8          |
| 5b4514-3    | 3.8           | .3*          | 81.8       | 12.1          |
| 6b3189-3    | 3.5           | 1.2          | 81.8       | 12.0          |
| 5b4546-4    | 3.3           | 0.9          | 81.8       | 12.0          |
| 6b3492-1    | 3.8           | 1.7          | 81.8       | 11.0          |
| 6b4967-3    | 3.6           | 2.1          | 81.8       | 11.0          |
| 6b4510-4    | 3.6           | 1.8          | 81.8       | 10.4          |
| 6b5351-4    | 3.2           | 0.9          | 81.8       | 11.9          |
| 6b4977-5    | 4.5           | 1.9          | 81.7       | 10.0          |
| 6b4510-1    | 3.7           | 2.0          | 81.7       | 10.3          |
| 6b4967-2    | 3.5           | 1.5          | 81.6       | 11.6          |
| 6b4967-1    | 3.4           | 1.7          | 81.6       | 11.3          |
| 5b4752-2    | 4.1           | 1.7          | 81.6       | 10.6          |
| 6b4344-4    | 3.7           | 1.4          | 81.6       | 11.6          |
| 6b2923-3    | 3.1           | 1.0          | 81.6       | 12.5          |
| 86b3493-2   | 3.5           | 1.0          | 81.6       | 12.4          |
| 5b2851-5    | 3.5           | 2.6          | 81.5       | 10.5          |
| 6b3307-2    | 3.5           | 1.1          | 81.5       | 11.9          |
| 5b4004-2    | 3.8           | 1.9          | 81.5       | 11.1          |
| 6b4511-2    | 3.5           | 1.9          | 81.5       | 11.4          |
| 5b3013-1    | 3.9           | 1.1          | 81.5       | 12.0          |
| 6b5501-2    | 4.1           | 2.0          | 81.5       | 10.3          |
| 6b4977-4    | 4.5           | 2.4          | 81.5       | 10.0          |
| 85b2958-3   | 3.2           | 1.2          | 81.5       | 12.1          |
| 6b3492-4    | 3.4           | 1.5          | 81.5       | 11.4          |
| 5b2203-3    | 3.2           | 1.4          | 81.5       | 12.2          |
| 6b4977-3    | 4.3           | 2.2          | 81.4       | 10.3          |
| 5b2042-2    | 3.3           | 1.6          | 81.4       | 11.9          |
| 5b3987-1    | 4.0           | 2.2          | 81.4       | 10.4          |
| 6b4978-3    | 3.6           | 2.6          | 81.4       | 10.4          |
| 6b4510-5    | 3.4           | 1.1          | 81.4       | 12.3          |
| 5b2042-5    | 3.2           | 1.6          | 81.4       | 12.0          |
| 6b4511-1    | 3.6           | 2.1          | 81.3       | 11.7          |

| SAMPLE<br># | %<br>PALMITIC | %<br>STEARIC | %<br>OLEIC | %<br>LINOLEIC |
|-------------|---------------|--------------|------------|---------------|
|             | 16:0          | 18:0         | 18:1       | 18:2          |
| 6b3492-5    | 3.5           | 1.5          | 81.3       | 11.8          |
| 6b4355-1    | 3.5           | 1.4          | 81.3       | 12.4          |
| 86b3493-4   | 3.6           | 1.8          | 81.3       | 11.8          |
| 5b2403-5    | 3.5           | 1.6          | 81.3       | 12.1          |
| 6b4967-5    | 3.5           | 1.3          | 81.2       | 12.6          |
| 6b4989-1    | 3.7           | 1.5          | 81.2       | 11.4          |
| 6b4978-1    | 3.8           | 2.8          | 81.2       | 10.6          |
| 5b2951-2    | 4.2           | 1.7          | 81.2       | 11.3          |
| 5b2089-2    | 4.0           | 1.3          | 81.2       | 11.8          |
| 5b4004-5    | 3.4           | 1.3          | 81.2       | 12.2          |
| 6b4384-3    | 3.8           | 1.4          | 81.2       | 12.3          |
| 5b3987-5    | 3.8           | 1.7          | 81.2       | 11.5          |
| 86b3243-5   | 3.2           | 0.9          | 81.2       | 13.2          |
| 6b3553-4    | 3.7           | 1.0          | 81.2       | 12.4          |
| 6b3242-4    | 3.9           | 1.0          | 81.1       | 13.3          |
| 5b2035-2    | 3.6           | 1.4          | 81.1       | 12.5          |
| 6b5501-3    | 4.8           | 2.1          | 81.1       | 10.1          |
| 6b4362-1    | 3.6           | 1.5          | 81.1       | 12.1          |
| 5b3750-2    | 3.6           | 2.7          | 81.1       | 10.7          |
| 5b4752-3    | 3.9           | .3*          | 81.1       | 11.9          |
| 6b3074-2    | 3.4           | 1.4          | 81.1       | 12.7          |
| 5b2033-4    | 3.5           | 1.5          | 81.0       | 12.2          |
| 6b3074-1    | 3.8           | 1.9          | 81.0       | 11.7          |
| 6b4937-5    | 3.4           | 0.9          | 81.0       | 13.3          |
| 5b3987-3    | 3.6           | 1.7          | 81.0       | 11.9          |
| 6b4977-2    | 4.3           | 1.8          | 81.0       | 11.0          |
| 5b4001-5    | 3.7           | 2.2          | 81.0       | 11.0          |
| 5b331-1     | 3.7           | 1.3          | 80.9       | 12.2          |
| 6b5487-3    | 3.7           | 1.5          | 80.9       | 11.6          |
| 5b2045-3    | 3.2           | 1.3          | 80.9       | 12.8          |
| 5b3750-1    | 3.9           | 2.4          | 80.9       | 11.1          |
| 5b2991-3    | 3.8           | 2.0          | 80.9       | 11.7          |
| 5b2032-2    | 3.4           | 1.3          | 80.9       | 12.8          |
| 5b4752-5    | 4.1           | 1.7          | 80.9       | 11.5          |
| 5b2043-4    | 3.4           | 1.2          | 80.9       | 12.8          |
| 5b4513-5    | 4.0           | .3*          | 80.8       | 13.1          |
| 5b2403-1    | 3.4           | 1.7          | 80.8       | 12.1          |
| 5b4002-1    | 3.8           | 1.8          | 80.8       | 12.0          |
| 5b4101-1    | 3.7           | 1.4          | 80.8       | 12.5          |
| 5b4752-4    | 3.7           | 1.5          | 80.8       | 12.4          |
| 6b5487-2    | 3.8           | 1.9          | 80.8       | 11.4          |
| 5b4817-5    | 3.9           | 2.2          | 80.7       | 10.9          |
| 5b4003-1    | 3.6           | 2.0          | 80.7       | 12.0          |
| 5b2029-1    | 3.6           | 1.6          | 80.7       | 12.3          |
| 6b5303-4    | 4.0           | 2.2          | 80.7       | 9.9           |
| 6b4511-5    | 4.0           | 1.7          | 80.7       | 12.2          |
| 5b4514-4    | 3.6           | 1.3          | 80.7       | 12.7          |

| SAMPLE<br># | %<br>PALMITIC | %<br>STEARIC | %<br>OLEIC | %<br>LINOLEIC |
|-------------|---------------|--------------|------------|---------------|
|             | 16:0          | 18:0         | 18:1       | 18:2          |
| 86b3493-3   | 3.8           | 1.6          | 80.7       | 12.3          |
| 86b3856-1   | 3.4           | 1.6          | 80.7       | 12.5          |
| 5b2089-5    | 4.3           | 1.6          | 80.7       | 12.1          |
| 5b216-3     | 4.1           | 1.5          | 80.7       | 11.9          |
| 6b3066-5    | 3.8           | 1.5          | 80.6       | 12.5          |
| 6b4968-1    | 3.5           | 3.0          | 80.6       | 11.5          |
| 5b3987-2    | 4.0           | 1.8          | 80.6       | 11.6          |
| 6b3066-1    | 3.9           | 1.7          | 80.6       | 12.2          |
| 6b4978-4    | 3.9           | 3.6          | 80.6       | 9.9           |
| 5b2034-1    | 3.9           | 2.0          | 80.6       | 12.2          |
| 6b5607-1    | 3.3           | 1.4          | 80.6       | 11.6          |
| 5b4514-4    | 3.8           | .2*          | 80.6       | 13.1          |
| 86b3068-5   | 3.3           | 1.4          | 80.5       | 13.1          |
| 6b5607-4    | 3.1           | 1.3          | 80.5       | 12.5          |
| 5b2089-3    | 3.9           | 1.3          | 80.5       | 12.5          |
| 6b4381-3    | 3.7           | 1.4          | 80.5       | 12.7          |
| 6b3066-3    | 3.6           | 1.3          | 80.5       | 13.1          |
| 5b2032-5    | 3.4           | 1.7          | 80.5       | 13.1          |
| 5b2046-5    | 3.4           | 1.4          | 80.5       | 13.1          |
| 5b3750-3    | 3.6           | 3.0          | 80.5       | 10.9          |
| 6b4503-1    | 4.2           | 1.6          | 80.5       | 12.7          |
| 5b2033-3    | 3.4           | 1.5          | 80.5       | 13.1          |
| 5b4001-4    | 3.9           | 2.4          | 80.5       | 12.7          |
| 5b2029-3    | 3.6           | 1.7          | 80.4       | 12.4          |
| 5b4003-2    | 3.6           | 1.9          | 80.4       | 12.5          |
| 5b2043-5    | 3.5           | 1.3          | 80.4       | 13.1          |
| 5b2029-5    | 3.6           | 1.6          | 80.4       | 13.0          |
| 6b4502-2    | 4.3           | 1.6          | 80.4       | 12.3          |
| 6b3551-2    | 3.9           | 1.1          | 80.4       | 12.8          |
| 6b4507-5    | 4.0           | 1.7          | 80.4       | 12.4          |
| 5b216-1     | 4.1           | 2.3          | 80.4       | 11.1          |
| 5b2045-5    | 3.0           | 1.1          | 80.4       | 14.1          |
| 6b4970-1    | 3.9           | 1.9          | 80.3       | 11.9          |
| 6b4510-2    | 3.5           | 1.7          | 80.3       | 11.9          |
| 6b4344-3    | 3.8           | 2.0          | 80.3       | 11.9          |
| 5b4817-4    | 4.0           | 2.1          | 80.3       | 11.5          |
| 5b2402-3    | 3.2           | 1.6          | 80.3       | 12.6          |
| 86b4508-1   | 4.1           | 2.1          | 80.3       | 11.7          |
| 5b331-1     | 3.9           | 1.7          | 80.3       | 12.3          |
| 5b4817-2    | 3.7           | 2.2          | 80.3       | 11.5          |
| 5b2092-1    | 4.3           | 1.1          | 80.3       | 12.6          |
| 5b4002-4    | 3.5           | 2.3          | 80.3       | 11.6          |
| 6b5501-4    | 4.3           | 2.2          | 80.3       | 11.0          |
| 86b2926-2   | 3.3           | 1.6          | 80.3       | 12.5          |
| 5b2042-4    | 3.4           | 1.4          | 80.3       | 13.2          |
| 5b4752-1    | 4.0           | 1.7          | 80.3       | 11.8          |
| 5b4001-2    | 3.8           | 3.1          | 80.2       | 11.6          |

| SAMPLE<br># | %<br>PALMITIC | %<br>STEARIC | %<br>OLEIC | %<br>LINOLEIC |
|-------------|---------------|--------------|------------|---------------|
|             | 16:0          | 18:0         | 18:1       | 18:2          |
| 5b2091-5    | 4.5           | 1.6          | 80.2       | 11.9          |
| 6b4381-5    | 3.7           | 1.3          | 80.2       | 13.3          |
| 5b2091-1    | 3.9           | 1.2          | 80.2       | 12.8          |
| 6b4295-1    | 3.4           | 1.1          | 80.2       | 13.5          |
| 5b4486-1    | 3.9           | 1.8          | 80.2       | 12.4          |
| 6b5356-2    | 3.7           | 1.1          | 80.2       | 13.5          |
| 5b2951-4    | 4.6           | 2.3          | 80.2       | 11.6          |
| 5n4101-2    | 4.0           | 1.6          | 80.2       | 12.7          |
| 6b4381-1    | 3.7           | 1.2          | 80.2       | 13.2          |
| 5b216-5     | 4.3           | 2.4          | 80.1       | 11.3          |
| 6b4977-1    | 4.5           | 2.0          | 80.1       | 11.4          |
| 5b3013-4    | 3.8           | 1.4          | 80.1       | 13.1          |
| 5b2885-3    | 3.6           | 1.4          | 80.1       | 13.6          |
| 5b2028-3    | 3.6           | 1.4          | 80.1       | 13.4          |
| 5b2403-3    | 3.4           | 1.5          | 80.1       | 13.6          |
| 6b3953-4    | 3.5           | 1.6          | 80.1       | 12.7          |
| 8b64508-5   | 3.8           | 1.8          | 80.1       | 12.8          |
| 5b2398-4    | 3.2           | 1.4          | 80.1       | 13.3          |
| 5b2043-1    | 3.3           | 1.3          | 80.1       | 13.7          |
| 5b2033-5    | 3.5           | 1.2          | 80.1       | 13.6          |
| 5b4817-1    | 4.0           | 2.3          | 80.1       | 11.5          |
| 6b4935-3    | 3.8           | 1.3          | 80.0       | 13.6          |
| 6b2922-4    | 3.3           | 1.0          | 80.0       | 14.3          |
| 5b4001-3    | 3.6           | 2.0          | 80.0       | 12.5          |
| 6b4981-5    | 3.5           | 2.0          | 80.0       | 11.8          |
| 5b4004-4    | 3.4           | 1.2          | 80.0       | 13.5          |
| 5b3011-3    | 3.5           | 1.4          | 80.0       | 13.3          |



HIGH LYSINE-  
METHIONINE  
LINES



The 4,000 plus breeding lines of safflower involved in Milestone 3 were analyzed for the quantity of amino acids lysine and methionine present in the seed. Since analyses for these amino acids by analytical chemistry require more time than was available for over 4,000 samples, a bioassay of the lines was carried out by Dr. David Sands and Mr. Peter Siderius of the Plant Pathology Department at Montana State University.

In this procedure, advantage is taken of the fact that the bacteria strain, Pediococcus serevisiae, which is sensitive to the presence of lysine and methionine, fails to grow on media lacking in either one or the other of these amino acids. However, when a half excised safflower seed (which contains the lacking amino acid) is placed on the media, growth of the sensitive bacteria is initiated around the seed. The size of this growth ring is proportionate to the amount of either lysine or methionine (depending upon which is being measured) present in the seed. The bacterial growth is compared to that of a standard safflower variety. The safflower variety used as the standard is Hartman.

The results show great differences in lysine or methionine content between breeding lines when you look at the measurements as a function of the area. Hence, a breeding line with a zone diameter of 40 mm contains approximately twice as much lysine or methionine as a line with a zone diameter of 30 mm ( $\pi r^2$  = area of a circle).

Table 1. High lysine lines ( $> 28$  mm diameter zone)

| Sample<br># | Diameter<br>of Zone | Sample<br># | Diameter<br>of zone |
|-------------|---------------------|-------------|---------------------|
| 638-3       | 35                  | 2375-5      | 32                  |
| 790-2       | 35                  | 2398-5      | 28                  |
| 853-5       | 32                  | 2402-4      | 33                  |
| 930         | 38                  | 2441-1      | 37                  |
| 1025-3      | 29                  | 2558-1      | 31                  |
| 1030-5      | 32                  | 2561-1      | 37                  |
| 1128-3      | 29                  | 2649-5      | 38                  |
| 1217-3      | 40                  | 2891-5      | 33                  |
| 1275        | 30                  | 2911-5      | 33                  |
| 1285-1      | 31                  | 2937-5      | 31                  |
| 1501-5      | 32                  | 2981-2      | 37                  |
| 1773-4      | 36                  | 3065-1      | 36                  |
| 1777-5      | 30                  | 3129-3      | 33                  |
| 1781-4      | 29                  | 3287-3      | 27                  |
| 1786-3      | 30                  | 3289-5      | 36                  |
| 1846-4      | 34                  | 3296-5      | 28                  |
| 1961-1      | 33                  | 3582-2      | 43                  |
| 1988-1      | 28                  | 3648-8      | 30                  |
| 2015-5      | 32                  | 4013-1      | 37                  |
| 2057-5      | 30                  | Hartman     | 16                  |

The -# following the regular sample # indicates a particular lot.

Table 2. High methionine lines (&gt; 28 mm diameter zone)

| Sample<br># | Diameter<br>of zone | Sample<br># | Diameter<br>of zone |
|-------------|---------------------|-------------|---------------------|
| 1285-1      | 32                  | 1785        | 35                  |
| 1376-1      | 30                  | 1786-3      | 36                  |
| 1416-5      | 30                  | 1846-4      | 47                  |
| 1424-5      | 29                  | 1961-1      | 44                  |
| 1433-1      | 28                  | 1988-1      | 36                  |
| 1455-3      | 30                  | 2042-5      | 31                  |
| 1457-4      | 39                  | 2055-5      | 29                  |
| 1503-5      | 30                  | 2073-5      | 31                  |
| 1528-2      | 32                  | 2150-1      | 47                  |
| 1532-5      | 31                  | 2192-5      | 31                  |
| 1534-4      | 29                  | 2206-5      | 34                  |
| 1545-4      | 30                  | 2264-5      | 30                  |
| 1551-4      | 30                  | 2375-5      | 35                  |
| 1595-1      | 35                  | 2398-5      | 34                  |
| 1596-2      | 29                  | 2410-5      | 30                  |
| 1701        | 29                  | 2523-1      | 46                  |
| 1717-5      | 32                  | 2545-1      | 31                  |
| 1722-5      | 28                  | 2561-1      | 45                  |
| 1773-4      | 34                  | 2649-5      | 47                  |
| 1777-5      | 35                  | 2806-5      | 30                  |
| 1781-4      | 34                  | 2814-3      | 31                  |

Table 2. High methionine lines ( &gt; 28 mm diameter zone)

| Sample<br># | Diameter<br>of Zone | Sample<br># | Diameter<br>of Zone |
|-------------|---------------------|-------------|---------------------|
| 2828-5      | 35                  | 3296-5      | 31                  |
| 2858-5      | 34                  | 3353-3      | 30                  |
| 2873        | 32                  | 3405-5      | 35                  |
| 2889-5      | 30                  | 3423-5      | 45                  |
| 2898-5      | 33                  | 3428        | 30                  |
| 2897-5      | 40                  | 3433-5      | 51                  |
| 2911-5      | 46                  | 3467-5      | 32                  |
| 2921-5      | 45                  | 3496-1      | 39                  |
| 2925-1      | 29                  | 3506-5      | 31                  |
| 2931-5      | 29                  | 3530-1      | 30                  |
| 2932-5      | 34                  | 3535-1      | 30                  |
| 2953-5      | 37                  | 3561-5      | 40                  |
| 2964-1      | 31                  | 3563-5      | 37                  |
| 2965        | 39                  | 3665-6      | 29                  |
| 2976-4      | 31                  | 3575-1      | 30                  |
| 3065-1      | 44                  | 3583-5      | 35                  |
| 3117-2      | 38                  | 3589-2      | 39                  |
| 3134-3      | 33                  | 3994-2      | 30                  |
| 3275-5      | 32                  | 4013-1      | 34                  |
| 3287-3      | 32                  | 4108-3      | 33                  |
| 3289-5      | 43                  | 4429-2      | 29                  |

Table 2. High methionine lines (✓ 28 mm diameter zone)

| Sample<br># | Diameter<br>of Zone | Sample<br># | Diameter<br>of Zone |
|-------------|---------------------|-------------|---------------------|
| 4448        | 34                  | 4585-2      | 32                  |
| 4484-5      | 30                  | 4634-1      | 32                  |
| 4493        | 30                  | 4857-1      | 38                  |
|             |                     | Hartman     | 13                  |

The -# following the regular sample # indicates a particular lot.

Table 3. High lysine and methionine combinations

| Sample # | Lysine Zone<br>millimeters<br>(rank) | Methionine Zone<br>millimeters<br>(rank) | Combination*<br>Ranking |
|----------|--------------------------------------|------------------------------------------|-------------------------|
| 1285-1   | 31 (13)                              | 32 (18)                                  | (17)                    |
| 1773-4   | 36 (5)                               | 34 (14)                                  | (11)                    |
| 1777-5   | 30 (14)                              | 35 (12)                                  | (14)                    |
| 1781-4   | 29 (16)                              | 34 (14)                                  | (16)                    |
| 1786-3   | 30 (14)                              | 36 (10)                                  | (12)                    |
| 1846-4   | 34 (8)                               | 47 (1)                                   | (3)                     |
| 1961-1   | 33 (9)                               | 44 (5)                                   | (8)                     |
| 1988-1   | 28 (17)                              | 36 (10)                                  | (15)                    |
| 2375-5   | 32 (12)                              | 35 (12)                                  | (12)                    |
| 2398-5   | 28 (17)                              | 34 (14)                                  | (17)                    |
| 2561-1   | 37 (3)                               | 45 (4)                                   | (2)                     |
| 2649-5   | 38 (2)                               | 47 (1)                                   | (1)                     |
| 2897-5   | 33 (9)                               | 40 (8)                                   | (9)                     |
| 2911-5   | 33 (9)                               | 46 (3)                                   | (6)                     |
| 3065-1   | 36 (5)                               | 44 (5)                                   | (4)                     |
| 3287-3   | 27 (20)                              | 32 (18)                                  | (20)                    |
| 3289-5   | 36 (5)                               | 43 (7)                                   | (6)                     |
| 3296-5   | 28 (17)                              | 31 (20)                                  | (19)                    |
| 3589-2   | 43 (1)                               | 39 (9)                                   | (4)                     |
| 4013-1   | 37 (3)                               | 34 (14)                                  | (9)                     |

\* This ranking is gotten by adding the lysine ranking and the methionine ranking and then putting the sum in order.

SAFFLOWER  
ECONOMIC  
CALCULATIONS



BREAK-EVEN PRICE OF VEGETABLE OIL FOR SUBSTITUTE DIESEL FUEL USE BASED ON  
SAFFLOWER BREEDING LINES LISTED IN MILESTONE 3A OF RAE 85-1054

|                                                   |                                    |
|---------------------------------------------------|------------------------------------|
| Safflower meal price per ton at 22% protein       | \$ 60.00                           |
| Oil extraction recovery                           | 98.5%                              |
| Lbs/gal safflower                                 | 7.7                                |
| Meal shrinkage of 4% = market meal                | 96.0%                              |
| Safflower yield, avg. lbs/acre, 1982              | 1,290                              |
| Production costs per acre with land, 1982         | \$157.93                           |
| Production costs per acre with land, 1987         | \$124.56                           |
| Production costs per acre w/o land and management | \$ 94.42                           |
| Variable production costs per acre                | \$ 53.04                           |
| Processing cost, 1982, \$/gal at \$20/ton         | \$ 0.22                            |
| Processing increase index, 1987/1982              | \$ 1.18 (\$0.2596/gal)<br>for 1987 |

SAFFLOWER PRODUCTION CROP BUDGET IN DOLLARS PER ACRE

|                                                   |              | <u>Note No.</u> |
|---------------------------------------------------|--------------|-----------------|
| Production: 1,290 lbs/acre                        |              | 1               |
| Variable Costs Per Acre                           |              |                 |
| Seed                                              | \$ 8.78      | 2               |
| Herbicide/insecticide                             | 7.75         | 3, 1987         |
| Fertilizer                                        | 10.68        | 4, 1987         |
| Machinery fuel & lube                             | 6.15         | 5, 1987         |
| Machinery repair                                  | 6.63         | 2               |
| Labor                                             | 8.57         | 6               |
| Interest on operating loan                        | <u>4.48</u>  | 2 @ 12%         |
| Total variable costs per acre                     | \$ 53.04     |                 |
| Fixed Costs Per Acre                              |              |                 |
| Ownership costs                                   | \$ 30.54     | 7               |
| Land rental                                       | 17.50        | 8               |
| General farm overhead                             | 10.84        | 9               |
| Management                                        | <u>12.64</u> | 9               |
| Total fixed costs per acre                        | \$ 71.52     |                 |
| Total Costs Per Acre                              | \$124.56     |                 |
| Costs without land rental and management per acre | \$94.42      |                 |

# SAFFLOWER PRODUCTION CROP BUDGET NOTES

1. Average dryland minimum and irrigated maximum safflower yields reported by Montana Eastern Agricultural Research Center (MEARC) 1978-1983.

1985 average production 1,110 lbs/acre  
1986 state-wide average production 1,250 lbs/acre

2. From "Liquid Biofuels in Montana: Assessment of the Oil Seed Resource." Hammaker, Geneva S., Feb. 1983, p. 131. Based on 1982 prices, but found to be similar or slightly higher in 1987.
3. From MEARC, Treflan is the only chemical applied. September 1987 cost is \$125/5 gal, applied at 1 quart/acre + \$1.50/acre application cost.
4. Recommended/usual Montana application is 20 lbs/acre N (34-0-0) at \$165/ton, sacked, 10/87 price; 50 lbs/acre P (18-46-0) at \$261/ton sacked, 10/87 price.

N = \$ 1.65/acre  
P = \$ 6.53/acre  
\$ 2.50/acre (application cost)  
\$10.68/acre

5. From Hammaker p. 131, 1982 cost = \$8.25 @ 1.02/gal, diesel #2

Fall 1987 delivered diesel cost is \$0.719 for #2  
0.799 for #1

= \$0.76/gal

From 3 state-wide dealers

(Billings, Miles City, Sidney, Helena) other products, similar, delivered.

\$8.25 = 1982 cost      \$0.76 x \$8.25 = \$6.15 = 1987 cost  
acre                      \$1.02                      acre

6. From Nelson-Farrar cost indexes, operating labor, 1982 = 559.9; May 1987 = 660.4. The 1982 cost was \$7.27, from Hammaker p. 131.
7. Ownership costs represent costs of replacing equipment, taxes, interest, and insurance. Since 1982, taxes and interest rates have declined (the large part of the cost). Insurance and replacement costs are assumed to increase similar to the cost of living index because not enough detail was presented in Hammaker report to reconstruct these cases. The 1982 cost was \$28.14. For 1987, the taxes and interest portion was held constant, and the replacement and insurance costs increased by 1.284 (rise in index from fall 1982 to September 1987).

\$28.14 x .7 = \$19.70 taxes, interest (12%)  
8.44 x 1.284 = 10.84 insurance & replacement  
\$30.54 1987 estimate

8. Land rental cost, 1987 for crop production in eastern, northern, and central Montana ASCS, Bozeman.
9. Increased from 1982 estimates of 9.19 and 10.72 (management) using Nelson-Farrar operating labor cost indexes.

ENERGY RATIO, SAFFLOWER : DIESEL FUEL, FOR PRODUCTION

Fuel & lube cost, 1982 = \$8.25/acre @ \$1.02/gal diesel

From: Hammaker, Geneva S. Liquid Biofuels in Montana; Assessment of Oil Seed Resources, Feb. 1983, DNRC, p. 131, Table VII - 3.

$$\frac{\$8.25/\text{acre}}{\$1.02/\text{gal diesel}} = \boxed{\frac{8.09 \text{ gal of diesel}}{\text{acre}}} \text{ used to produce safflower}$$

Average Montana yield = 1,200 lbs/acre safflower seed

Average oil content, wt. % of seed = 38%

1 gal safflower = 7.7 lbs. of safflower oil, 68° F.

From: RAE 85-1054, MSU-Eastern Agricultural Research Center, Milestone 3

$$\left( \frac{1,200 \text{ lbs seed}}{\text{acre}} \right) \times \left( \frac{0.38 \text{ lb oil}}{\text{lb seed}} \right) \times \frac{1 \text{ gal}}{7.7 \text{ lbs oil}} = \boxed{\frac{59.2 \text{ gal of safflower}}{\text{acre}}}$$

Finally, from Peterson, C.L. Performance Testing of Vegetable Oil for Diesel Fuel. Univ. of Idaho, American Society of Agricultural Engineers. Dec., 1981. p. 23, Table 2.

high heating value

|                        |             |   |                 |
|------------------------|-------------|---|-----------------|
| No. 2 diesel           | 38,498 KJ/L | = | 138,690 Btu/gal |
| Linoleic safflower oil | 36,379 KJ/L | = | 131,056 Btu/gal |

$$\begin{aligned} \text{Btu product} &= \frac{59.2 \text{ gal safflower}}{\text{acre}} \times \frac{131,056 \text{ Btu}}{\text{gal}} = 7.76 \times 10^6 \frac{\text{Btu}}{\text{safflower}} \\ \text{Btu production} &= \frac{8.09 \text{ gal diesel}}{\text{acre}} \times \frac{138,690 \text{ Btu}}{\text{gal}} = 1.12 \times 10^6 \frac{\text{Btu}}{\text{diesel}} \end{aligned}$$

or 6.91 Btu's of safflower fuel are produced for every Btu of diesel used.

# ESTIMATED ANNUAL SAVINGS RESULTING FROM RAE 85-1054 SAFFLOWER WORK

Grant Cost = \$216,000

1987 break-even cost of safflower oil, 36% oil = \$1.92/gal

1987 break-even cost of safflower oil, 45% oil = \$1.47/gal

Oil yield, 36% oil = 59.4 gal/acre

Oil yield, 45% oil = 63.2 gal/acre

1986 acres of safflower harvested = 112,000

1987 acres of safflower harvested = 161,000

Annual cost saved = (change in oil cost, \$/gal) x  
 (change in %  $\frac{\text{gal}}{\text{acre}}$ ) x annual acres

= \$ (1.92 - 1.47) /gal x  $\left(\frac{1-63.2 - 59.4}{59.4}\right) \frac{\text{gal}}{\text{acre}}$  x (112,000) acres

= (.45) (1.064) (112,000) = \$53,624 in 1986, poor year

= (.45) (1.064) (161,000) = \$77,087 in 1987, good year

## Simple Payback

$\frac{\$216,000}{\$ 53,624/\text{yr}}$  = 4.03 years;  $\frac{\$216,000}{\$ 77,087}$  = 2.8 years

$\frac{\$216,000}{\$ 65,356 /2 \text{ year avg.}}$  = 3.3 years



